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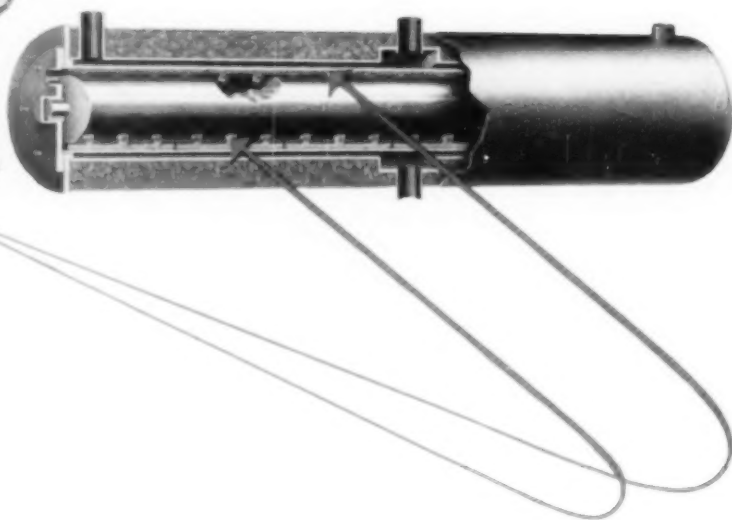
For JANUARY, 1946 • CHEMICALS — FROM WAR TO PEACE — FEATURE 23RD ANNUAL
REVIEW • PETROLEUM AS CONSUMER OF CHEMICALS • SOME DO'S AND DON'T'S IN MIXING
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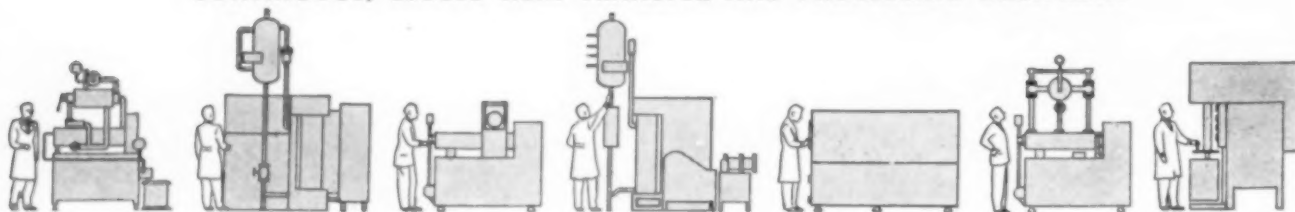
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CHEMICAL ENGINEERING

JANUARY • 1946

Volume 53

Number 1

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Published monthly. Price 35 cents per copy.
Publication office, 99-129 North Broadway,
Albany 1, N. Y. Address communications
about subscriptions to Vice-President (for
circulation operations), Chem. & Met., 330
West 42nd St., New York 18, N. Y. Sub-
scription rates: United States, Mexico, Central
and South American Countries, \$3 per year,
\$4 for two years, \$5 for three years. Canada
\$3.50 per year, \$5 for two years, \$6 for
three years (payable in Canadian funds). All
other countries, \$5 per year, \$10 for three
years. Please indicate position and company
connection on all subscription orders. Entered
as second class matter September 3,
1936, at Post Office at Albany, N. Y.,
U.S.A. under act of March 3, 1879. Copy-
right 1946 by McGraw-Hill Publishing Com-
pany, Inc.—all rights reserved. Branch of-
fices: 520 North Michigan Avenue, Chicago
11; 68 Post Street, San Francisco 4; Ald-
wych House, Aldwych, London, W. C. 2;
Washington 4; Philadelphia 2; Cleveland
15; Detroit 26; St. Louis 8; Boston 16; Los
Angeles 14; Atlanta 3; Pittsburgh 22.

Return Postage Guaranteed

McGraw-Hill Publishing Co.,
INC.

JAMES H. McGRAW
Founder and Honorary Chairman

Publication Office
99-129 North Broadway, Albany 1, N. Y.
Editorial and Executive Offices
330 West 42nd Street, New York 18, N. Y.
JAMES H. McGRAW, JR., President;
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INCENTIVES FURNISH THE DRIVE

THE COMING YEAR, 1946, and the years to follow can bring unprecedented prosperity to the people of the United States if the incentives to secure it are provided.

We have the advantage of starting with an economy which has demonstrated a capacity for expansion unequalled in any other country in the world. Our economy has demonstrated, also, one grave weakness—a recurring interruption of the upward trend of production and living standards by wasteful and paralyzing periods of recession. Recovery from each depression always has carried us to new heights of economic welfare, but the toll of the years of blight has been harmful to everyone.

The job ahead of us is a dual one. We must maintain the vitality of an economy which, over the years, has yielded an enormous increase in the American standard of living, and we also must improve its stability.

The Dynamics of American Production

In the last prewar year, 1940, the population of the United States was $3\frac{1}{2}$ times as large as it was in 1870. But the national production, measured in dollars of constant purchasing power, was 10 times as large at the end of the period, and industrial output had increased 20-fold.

In the meantime, the average number of hours of factory workers had been reduced from about 63 per week in 1870 to less than 40 in 1940, while average hourly earnings had more than trebled in dollars of constant purchasing power. Thus "real" weekly or annual wages in manufacturing had doubled over the 70-year period, even though the work-week was cut by 35 per cent. This was made possible chiefly by a tremendous increase in the quantity and quality of the mechanical facilities which were provided in American manufacturing industry. Manufacturing capital investment per worker was multiplied by 6 times over the period in question. But the

return per dollar invested, while it has fluctuated widely between good years and bad, showed no general upward trend over that portion of the period for which measurement is practicable.

Incentives in American Manufacturing

There has been, historically, a remarkably consistent pattern in the division of the realized income from the expanding manufacturing output of America. Reliable statistics are not available for as far back as 1870, but from 1899 through 1939 the average share of wages and salaries has been $82\frac{1}{2}$ per cent against $17\frac{1}{2}$ per cent as the share to investors (including dividends, interest, rents, royalties, and non-corporate profits). There have been, from year to year, relatively minor divergences from this pattern of distribution, but there is no discernible trend during the period away from the averages cited.

It is suggested that the persistence of the average $17\frac{1}{2}$ per cent share of realized income from manufacturing that was maintained for the 40 years preceding World War II may represent the proportion that is needed to produce the dividends, interest, rents, royalties, and non-corporate return that will provide for the continuing investment upon which an expanding productivity such as we have had in the past depends. At any rate, it would seem reckless to depart too radically from such an established pattern at a time when unprecedentedly large private capital investment is counted on to make up for the drastic curtailment of such investment during the war years, and to carry us to the new high levels of civilian production set as our postwar goals.

The Distribution of Manufacturing Income in War

At the beginning of the war, the Government adopted controls and a tax program designed to prevent wartime activity from resulting in un-

duly swollen private returns. Due primarily to huge volumes, the profits *before* taxes of manufacturing industry were very high, but throughout the war its profits *after* taxes averaged returns no larger than they had been in good prewar years. Relative to volume, they were considerably lower than in prosperous years in the past. Again, there can be no complaint at results that generally were in accord with a national wartime policy.

But it is fair to note that the wages of manufacturing labor were allowed to increase substantially during the war. Between January 1, 1941 and April, 1945, average weekly earnings per worker increased by 77 per cent. This was, in considerable part, a result of increased working hours and a shift from low- to high-paid industries, but straight-time hourly earnings on the same jobs increased about 40 per cent against a cost-of-living rise of about 30 per cent.

The net result was to alter drastically the 40-year relationship of the $17\frac{1}{2}$ - $82\frac{1}{2}$ per cent division of Realized Income from Manufacturing. The share of wages and salaries increased to over 90 per cent, and the investment share shrunk to less than 10 per cent.

Its Postwar Distribution

This wartime shift in the proportion of distributive shares has an important bearing upon current wage controversies. With union demands for wage increases ranging up to 30 per cent, and the economists of the Office of War Mobilization and Reconversion asserting that an average increase of 24 per cent is feasible without raising prices, it is pertinent to inquire how such increases would affect the prewar ratios that governed realized income distribution in manufacturing.

Forecasting is always hazardous, but if we assume (1) that in 1946 we shall reach the \$160 billion level of national output which the Government proponents of general wage increases expect, and (2) that there will be little increase in productivity because of the continuing process of reconversion, and (3) that the Government will succeed in carrying its announced purpose

to maintain present price ceilings, it appears that a 24 per cent general wage increase would reduce the share going to capital from $17\frac{1}{2}$ per cent to 11 per cent even allowing for its increased return resulting from the repeal of the excess profits tax. The prewar ratios would be about maintained if wages remained at present levels.


Conclusion

Since the maintenance of these prewar ratios was accompanied by an unparalleled rise in the "real wage" of American workers, there is a powerful *prima facie* case for not tinkering with them. It should be noted, however, that some economists think that the size of the investment share of manufacturing income tends to provide more capital than can be absorbed by a mature economy, and thus contributes to those breaks in the expansion of the economy which, as stated at the outset, have been its principal blight.

Regardless of what may ultimately prove to be the validity of this view, no one can responsibly contend that at this early but crucial stage in the reconversion process is the time to test it. Now, no one knows whether, or what dimension of, additional wage increases can be supported without forcing up prices or reducing profits to a point that will discourage vitally needed private capital investment.

We want high and increasing wages in American manufacturing. We need them to provide an active incentive to workers to support expanding productivity, as well as to continue the trend of rising living standards in America. Equally, we need a continuing profit incentive of sufficient attractiveness to call forth the new investment upon which expanding productivity depends.

We can never attain our dual objective if we push one of these aims so far and so fast that it defeats the other.



President, McGraw-Hill Publishing Co., Inc.

CHEMICAL & Metallurgical ENGINEERING

ESTABLISHED 1902

S. D. KIRKPATRICK, Editor

JANUARY 1946

CHEMICALS From War Into Peace



AS WE MOVE farther from war into peace, it becomes increasingly evident that chemicals are destined to play a basic role in the years ahead. Their contribution to the making of munitions was of vital importance, yet as we look back on it that problem was in many ways simpler than the one we face today. Then we concentrated on relatively few commodities with volume rather than variety, quantity rather than

quality, the more pressing consideration. Now the emphasis shifts to a broader program, calling for new effort and resources. What we learned in new techniques and organization for war production must be projected into many peacetime applications.

Surprisingly enough, there has been little let-up in the volumes demanded, especially for heavy chemicals. For some of these more basic materials, the manufacturers have found it necessary to continue a voluntary system of allocation. They have asked their customers to limit their demands to the quantities actually delivered on last year's contracts, even though this may mean a postponement of plans for a number of postwar projects. Fortunately this delay should not be of long duration because a better balancing of facilities should follow the present period of transition and uncertainty. Meanwhile we must not make the mistake of merely taking it for granted that heavy chemicals are made in such volumes that ample supplies will always be available. Nor, on the other hand, should we rush into the market in an attempt to build up excessive inventories of basic materials that are badly needed to advance all phases of the reconversion program. In short, we benefit most by moving forward with industry as a whole.

Fine chemicals, organic synthetics and their derivatives, are freer to advance in output as new markets open and older ones are resumed. However, this industry has been one of the first to feel the shortage of technical manpower, not only in research and development, but also in production and sales. Many of its plants still have reconversion problems and certain branches, such as plastics, face the need for greatly expanded facilities. Some specialties that go directly into consumer goods can and are moving rapidly ahead. Others that go into industrial products are naturally affected by the progress or lack of progress being made in the production of other components. Resumption of activity in the steel and automobile industries is certain to have a salutary effect on the chemical and process industries, not because they are necessarily important markets in themselves, but because they affect so many other phases of our national economy.

In five years of war and preparation for war, we have more than doubled the size of the chemical industry of this country. Its output is now available for peacetime production and, judging from past experience, at least three-quarters of the total will be consumed within the industries that depend upon chemical engineering processes and equipment. To promote a better understanding of what this situation holds for all of us, *Chem. & Met.* opens its 53rd volume with a graphic study of the underlying "Facts and Figures of the American Chemical Industry"—the 23rd in our series of annual review and statistical issues. Herein lies the foundation on which we must build for peacetime progress.

Sidney S. Kirkpatrick



From 5 Years of War a \$3,000,000,000 Chemical Industry for Peace

PERHAPS it is too soon to appraise in proper perspective the changes which the past five historic years have wrought in our chemical economy. Certainly they have been far reaching. They have demonstrated resourcefulness, strength and productivity far beyond any of our expectations. The fact that this country's constantly expanding war program was never held up seriously for lack of essential chemicals is a well deserved tribute to the industry, to its management and labor and to those in government who helped to coordinate and direct its war effort into the most effective channels.

During five years prior to V-J Day, the Chemicals Bureau of the War Production Board directed the allocation of approximately \$10 billion worth of chemicals. During the first quarter of 1945 the total for allocated shipments exceeded a billion dollars. This record, says the WPB, was possible only because of "close cooperation between industry and government, aided by industry advisory committees and the technical ingenuity of the chemical industry in overcoming bottlenecks in production."

PRODUCTION PEAKS

Prior to the war, the American chemical industry, as such, had an output valued at approximately \$1.33 billions as compared with about \$3.7 billion for the census grouping of "Chemical and allied industries" and about \$12 billion for the "Chemical process

industries." Since 1939 the total for chemicals has more than doubled, reaching a total in 1944 of \$2,979,000,000. Chemical and allied industries during the same period had mounted to \$8.3 billion while the chemical process industries had exceeded \$22 billion (See chart on page 110).

Despite the heavy war demands for such important chemicals as sulphuric acid, soda ash, caustic soda and chlorine, the outstanding gains in both volume and value were made by the coal-tar products and synthetic organic chemicals. The Tariff Commission has reported that coal tars and synthetic organics rose from a value of \$455,500,000 in 1939 to a peak of \$1,617,700,000 in 1944. And the end is not yet for these industries have already announced plans for heavy outlays for new plants.

Prior to the war the chemical industry normally spent approximately \$100 million for new construction as compared with about \$350 million for the chemical process industries. During the past five years, however, approximately \$4 billion of federal and private funds have been spent for chemical plant expansion alone, according to the War Production Board. The peak outlay came in 1941 when \$642 million were spent for facilities and \$420 million for equipment.

CONSUMPTION TRENDS

Outside of direct war uses, as in high explosives, the synthetic rubber and aviation gasoline programs have been the most prominent as new wartime markets for chemicals. The world-wide demand for increased food production stimulated the demand for fertilizer chemicals until they have reached record levels. Food needs will continue to be large for a long time to come and there is every reason to believe that the fertilizer industry will continue to operate at higher than its prewar levels.

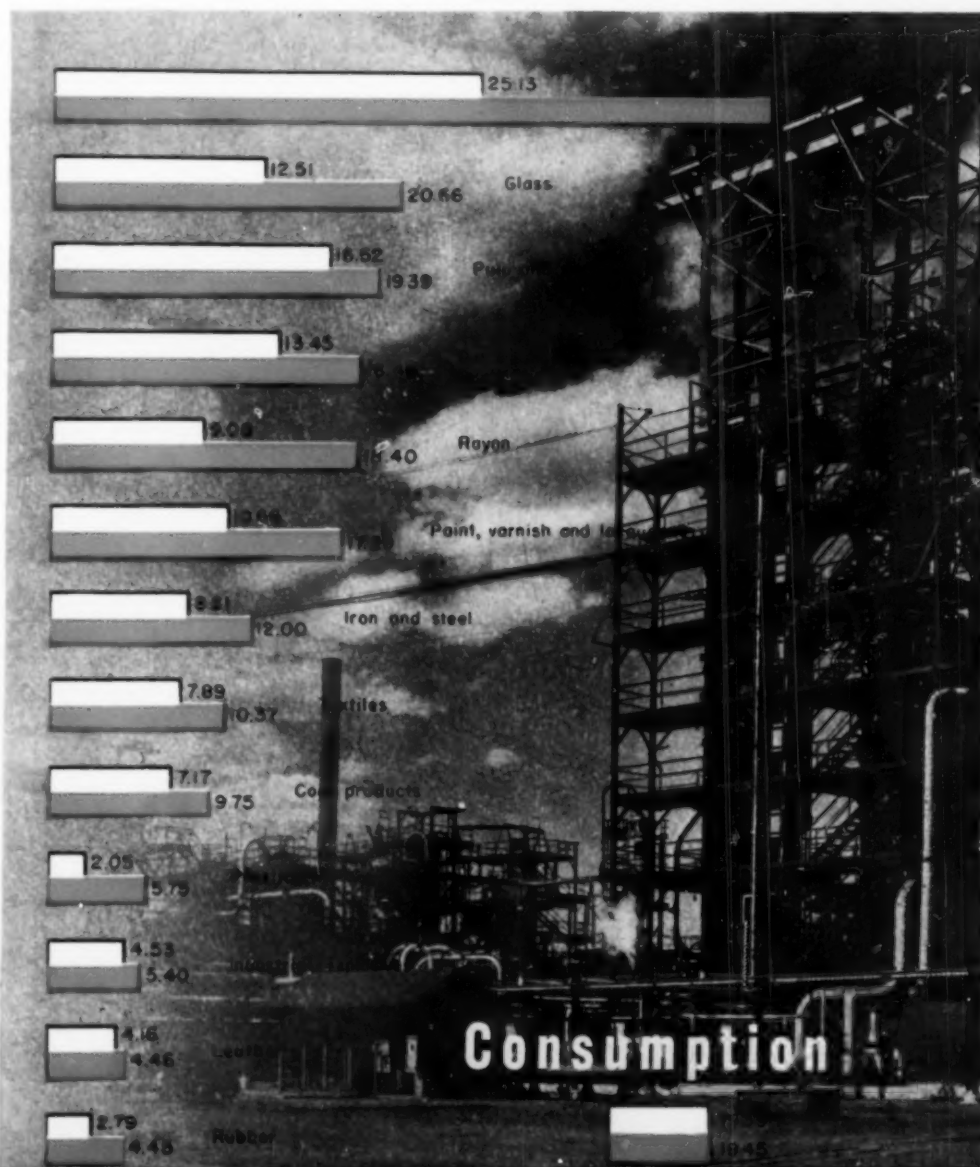
Spectacular wartime advances in rayon and plastics are certain to carry over in peacetime applications. Glass, paint and varnish and steel are needed for a tremendous postwar program of new home and industrial construction. A drop in gasoline production late in 1945 threatened the petroleum industry's record consumption of chemicals but any marked fall from wartime levels promises to be moderate. The cutback in synthetic rubber, which has required tremendous quantities of industrial alcohol, has affected other chemicals but the international position of rubber is still too uncertain to form any basis for future requirements.

The chemical industry has no serious re-conversion problem. In general its products are manufactured, shipped and consumed in much the same way for either war or peacetime applications. Except for such things as high explosives and war gases most chemicals will find ready use in the years ahead. Look for further slight recession from the wartime peak of 1944, but count on chemicals to continue their long time advances.

Chem. & Met. Indexes for Industrial Consumption of Chemicals

(1935 = 100)

	1939	1940	1941	1942	1943	1944	1945
Fertilizers.....	25.13	28.80	31.49	37.33	40.12	39.76	42.50
Pulp and paper.....	16.52	19.98	21.92	20.51	19.05	18.87	19.39
Glass.....	12.51	13.15	15.03	15.91	18.80	19.93	20.66
Petroleum refining...	13.45	14.08	15.20	14.43	15.56	18.10	18.55
Paint, varnish and lacquer.....	10.66	11.12	15.03	14.35	15.40	16.71	17.29
Iron and steel.....	8.21	10.54	12.88	13.32	13.49	13.33	12.00
Rayon.....	9.08	11.43	12.87	14.93	15.53	16.81	18.40
Textiles.....	7.89	8.52	11.06	11.97	11.43	10.53	10.37
Coal products.....	7.17	8.91	9.28	9.54	9.47	10.05	9.75
Leather.....	4.16	3.96	4.88	4.88	4.56	4.25	4.46
Industrial explosives...	4.53	4.91	5.54	5.73	5.52	5.06	5.40
Rubber.....	2.79	3.05	3.91	3.00	3.00	3.00	4.45
Plastics.....	2.05	2.77	3.71	4.36	4.80	5.24	5.75
	124.15	141.22	162.80	170.26	176.73	181.64	188.97



Enough Sulphur and Sulphuric Acid For \$25,000,000,000 of Industry Products

DURING the period of the Second World War the United States was never faced with a real threat to the supply of raw materials for sulphuric acid; and aside from superphosphate plants there was never a serious acid shortage elsewhere, except occasionally at particular localities where transport difficulties intervened, or new plant construction failed to keep pace with requirements. Acid was never in excessive supply, but there was enough for essential requirements despite the fears that had been expressed during the period of war preparation. This excellent performance may be credited to a combination of factors. Perhaps most important was the planning, whereby government and industry worked out the technique of expansion and of using spent acids. Then there were factors in the explosives picture that eased the acid needs. For example, since our nitric acid is now practically all synthetic, sulphuric acid is not needed for its manufacture, as it was in World War I. The actual nitrations were also carried out with a much smaller unit requirement for sulphuric acid than 25 years earlier. On the capacity side, it was found possible to add the enormous increase in concentrating equipment that was required,

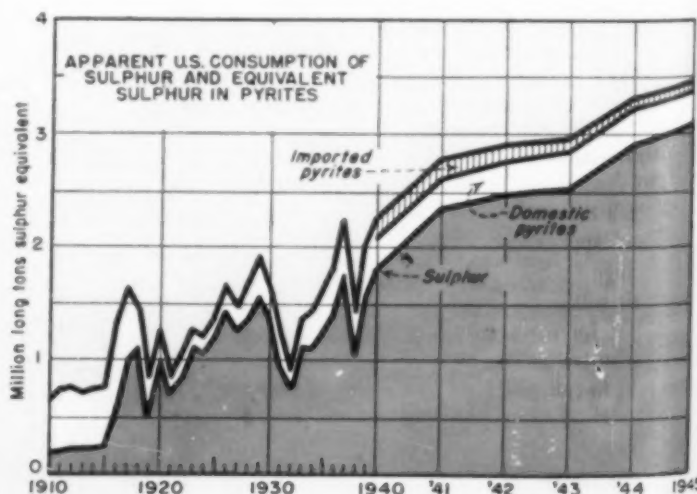
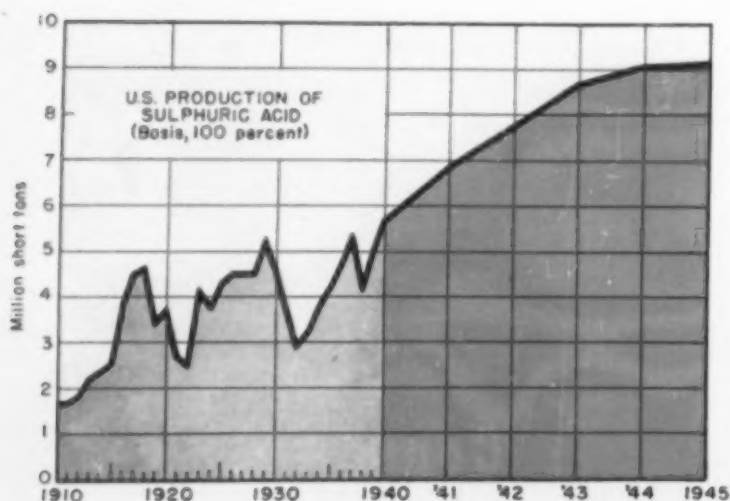
as well as considerable new acid capacity, more rapidly than had been anticipated; and many plants were operated far above their rated capacities, sometimes at 50 percent excess or even more.

All this would not have been possible, however, if raw materials had not been available when and as needed. Pyrites fell off sharply as the submarine war and shipping shortages made themselves felt, despite the best efforts of Canada and our domestic producers, but sulphur was on hand far in excess of the supplies of the First World War, and could have been drawn on to a still greater extent if it had been needed. There was never a time in the war years when there was not more than a year's needs above ground. In fact, it has been pointed out that sulphur was the only tonnage commodity so freely available during the war that the government several times urged users to stock up!

As compared with 1918, the peak year of the First World War, the production of sulphuric acid in 1945 was nearly double. Sulphur production, however, was almost three times that of the earlier year. Despite rather sharp decrease in acid producing rate after V J Day (several of the latest plants,

in fact, never operated), production in 1945 reached a total even above the 9,040,000 short tons (100 percent basis) estimated for 1944, and is believed to have been as much as 9,140,000 tons, or even a little higher. With a total capacity today in excess of 10,000,000 tons, the few hundred thousand tons additional that would have been needed if the war had not ended could have been supplied without difficulty.

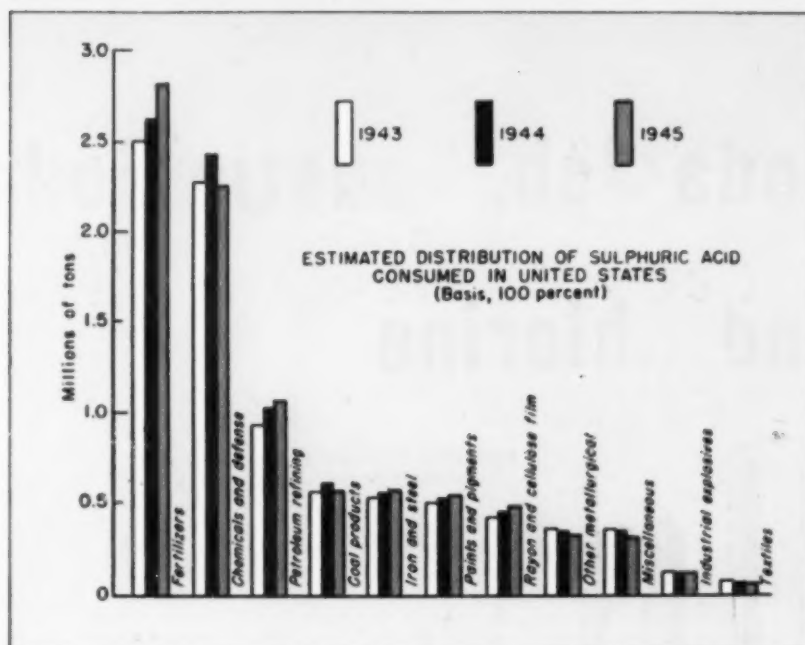
An accompanying tabulation, based on Bureau of Mines data and Chem. & Met. and trade estimates, shows the composite picture for sulphuric acid and its raw materials for the war years, as well as for 1940 and 1941. Although 1940 had seen the production of more acid than any previous year, exceeding both 1929 and 1937 by substantial margins, still it was topped by 60 percent in 1945. During this interval the only raw material complication came from pyrites imports. Where Spain had been the main factor in this field prior to 1941, its exports to our shores had fallen to a dribble by 1942. Domestic producers increased their output to about twice that of the 1914-1918 period, and Canada greatly increased its exports until one of its principal mines played out in 1943. Nevertheless, the



net result was a decrease in sulphur from pyrites that was, however, much more than compensated by increase in brimstone consumption. One of the accompanying charts that plots apparent consumption of sulphur in the United States, both that in pyrites and that in brimstone, makes evident the enormously increasing importance of the latter raw material in the period since World War I.

In spite of the reduction in acid needs since V-J Day, 1945 saw the establishment of several records both in the application of acid and in the production of the acid and its raw materials. Sulphur mining topped any previous year by a large margin, with the production of an estimated 3,760,000 long tons, nearly 9 percent over 1942, the largest previous year. Exports, estimated at 900,000 tons, set a record slightly higher than 1929. Domestic shipments, taken at 3,070,000 tons, were much above any earlier year except 1944. Acid production of an estimated 9,140,000 short tons was slightly more than 1 percent over 1944. Of the total, about 75 percent came from brimstone, about 15 percent from pyrites, slightly more than 9 percent from byproduct gases at smelters, and a little less than 1 percent from recovered hydrogen sulphide. About 61 percent was produced by the contact process, a slight reduction in the contact percentage compared with 1944.

Notable advances have occurred during the war in practically every field of acid use. For example, since 1940 the requirement for fertilizers has almost doubled, although a considerable part during the war years was spent acid from explosive plants and petroleum refineries. Addition of direct defense requirements to our Chemical classification has, of course, enormously increased consumption in this group of uses, taking nearly four times as much in 1945 as in 1940. Even the 1944 requirements were increased in 1945 in several important cases including fertilizers, petroleum refining, iron and steel, paints and pigments, industrial explosives, and rayon.



Estimated Distribution of Sulphuric Acid Consumed in the United States
(Short tons, 100 percent acid)

CONSUMING INDUSTRIES	1943	1944	1945
Fertilizers.....	2,500,000	2,620,000	2,800,000
Petroleum refining.....	940,000	1,020,000	1,070,000
Chemicals and defense*.....	2,285,000	2,425,000	2,240,000
Coal products.....	580,000	620,000	585,000
Iron and steel.....	535,000	560,000	580,000
Other metallurgical.....	360,000	340,000	320,000
Paints and pigments.....	495,000	530,000	545,000
Industrial explosives.....	115,000	110,000	115,000
Rayon and cellulose film.....	415,000	450,000	495,000
Textiles.....	85,000	75,000	70,000
Miscellaneous.....	350,000	340,000	310,000
Totals.....	8,650,000	9,090,000	9,130,000

* Combined to avoid disclosing estimates of direct war applications.

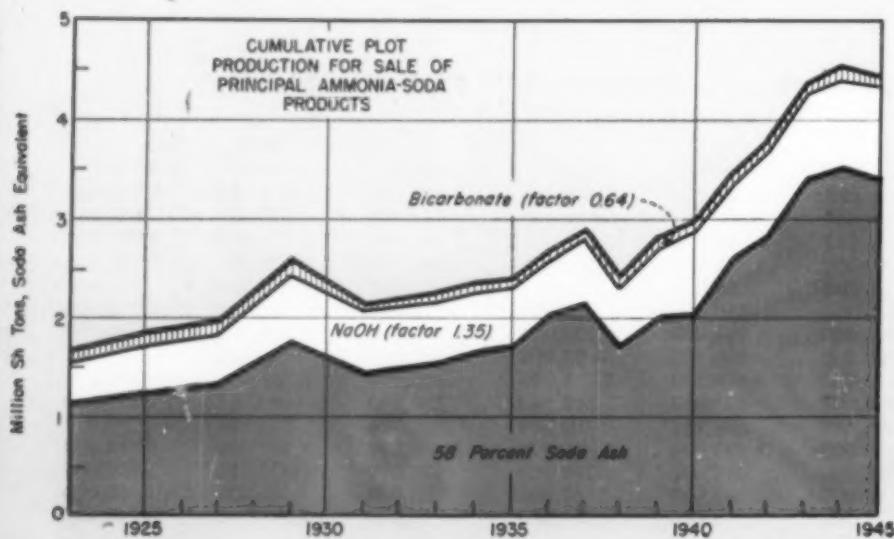
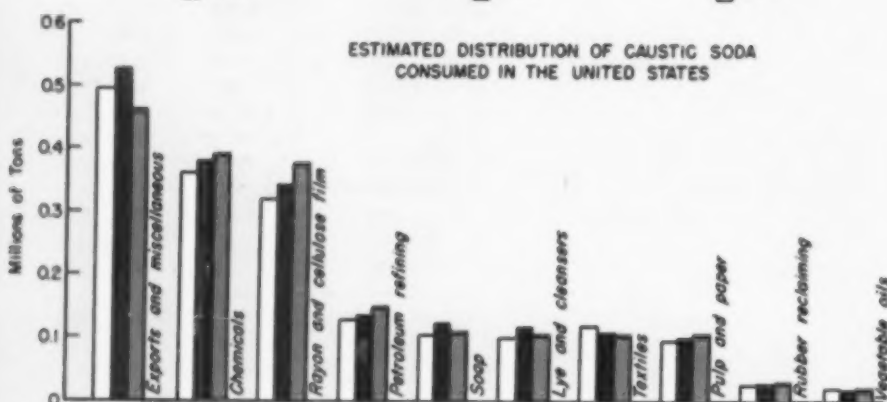
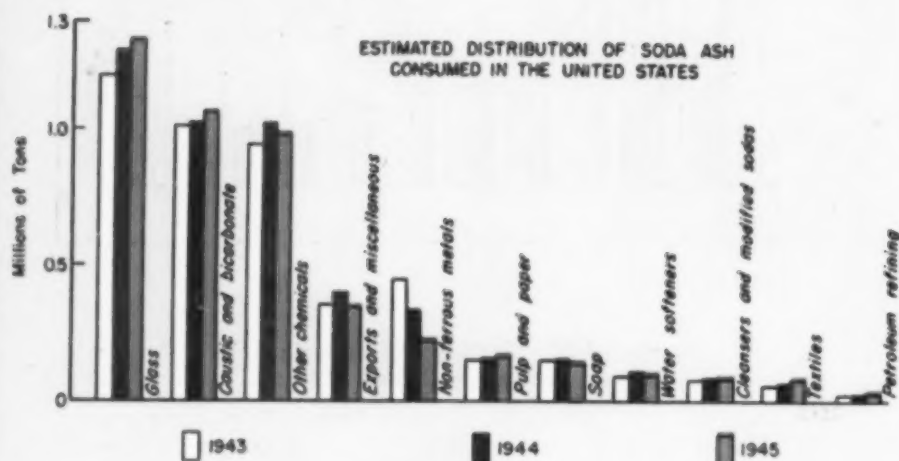
Data and Estimates on U. S. Sulphur Activity and Sulphuric Acid Production, 1940-1945
(Sulphur and pyrites in long tons; acid in short tons, 100 percent acid)

	1940	1941	1942	1943	1944 (Revised)	1945 ¹
Sulphur mined ²	2,732,088	3,139,253	3,460,686	2,538,786	3,218,158	3,760,000
Sulphur exports.....	746,468	729,464	568,249	654,393	653,686	900,000
Domestic shipments.....	1,812,247	2,671,946	2,560,310	2,299,452	2,925,000 ³	3,070,000 ³
Approx. mine stocks at end of year.....	4,200,000	3,900,000	4,300,000	3,800,000	3,500,000	3,350,000
Sulphur imports plus sulphur from fuel gases.....	31,000	33,000	30,000	21,000	5,000 ⁴	5,000 ⁴
Non-acid uses of sulphur.....	635,000	760,000	775,000	875,000	890,000	920,000
Sulphur available for acid.....	1,208,000	1,944,000	1,730,000	1,445,000	2,035,000	2,150,000
Non-mine stock changes ⁵	+100,000	+500,000	+85,000	-500,000	-80,000	.....
Acid from sulphur.....	3,545,000	4,620,000	5,535,000	6,225,000	6,765,000	6,876,000
Pyrites imports.....	407,004	368,838	300,140	256,380	180,763	198,000
Domestic pyrites.....	626,640	645,257	720,363	802,384	788,530	780,000
Acid from pyrites.....	1,460,000	1,435,000	1,440,000	1,445,000	1,340,000	1,354,000
Acid from smelters.....	655,000	712,000	746,000	930,000	875,000	850,000
Acid from hydrogen sulphide.....	50,000	45,000	61,000	55,000	60,000	60,000
Total sulphuric acid made.....	5,710,000	6,812,000	7,782,000	8,655,000	9,040,000	9,140,000

¹ Estimated from 9 or 10 months' figures. ² Includes western sulphur. ³ Includes deliveries from distributing points to agree with new Bureau of Mines reporting method employing "apparent sales." ⁴ Changes in users' and consignment stocks, plus producers' stocks at distributing points, except in 1944 when only users' stocks are included. ⁵ Included in domestic shipments.

Soda Ash, Caustic Soda and Chlorine

. . . Basic



ALTHOUGH some slackening in the pace of the alkali industries was evident before V-J Day, it was small and the totals for the entire year 1945 were only slightly less than those of the peak year of 1944. In fact, lime-soda caustic and natural soda were actually running ahead of any previous year, and finished up the year with totals that were records by substantial amounts. This came about in the case of caustic because that chemical for the first time in several years was in greater proportionate demand than chlorine. Caustic was in definitely short supply and the slack was taken up so far as possible by pushing the lime-soda plants at the same time that electrolytic plants were allowed to slacken off.

As a result of the war-built additions to the alkali industry, 1946 finds the industry with capacities all along the line that are well ahead of those of prewar years. A glance at the outputs of the later war years, in comparison with 1939 and 1940, will make this evident. In 1939 the Census placed soda ash production at 2,982,632 tons, of which 132,897 tons was natural and electrolytic soda. For 1940 we estimated that the comparable figures were 3,015,000 tons and 142,000 tons. When the peak had been reached in 1944, ammonia soda had reached 4,538,498 tons and natural and electrolytic, 179,940 tons, a total of 4,718,438 tons. Our estimates for 1945 (based on 9 months' figures) place ammonia soda at 4,308,000 tons, and the natural product at 182,000 tons, totalling 4,491,000 tons. This is 42 percent ahead of 1940, and only 4.8 percent below 1944.

U. S. Production of Chlorine In Private Plants

(Short Tons)

1929	199,472
1933	217,089
1935	315,139
1937	426,261
1939	514,401
1941	797,976
1942	987,784
1943	1,211,920
1944	1,259,500
1945 (est.)	1,170,000

From U. S. Bureau of Census except Chem. & Met. est. 1945.

Materials for Many Industries

The picture is no less striking in caustic soda and chlorine. Total caustic production in 1939 amounted to 1,025,046 tons, of which 52 percent was made by the lime-soda process. In 1940 we estimated the comparable figures at 1,100,000 tons and 46 percent. In the latter year the trend toward greater reliance on the electrolytic process was already appearing, owing to tremendously stepped up demand for chlorine. By 1944 the year's total output of caustic, 1,894,604 tons, was nearly 64 percent electrolytic, and although the trend was less pronounced in 1945 for the reason already mentioned, still 61 percent of the 1,825,000 tons we believe was made came from the cells of the electrolytic producers. Thus, output in 1944 exceeded 1940 by 72 percent, while the decrease from 1944 to 1945 was less than 5 percent.

In the case of chlorine the change is even more emphatic. Where there was a production of 514,401 tons in 1939, and an estimated 1940 output of 635,000 tons, 1944 production soared to 1,259,500 tons in privately owned plants alone. Dropping only 7 percent, chlorine production in 1945 is estimated to have reached 1,170,000 tons which is nearly 85 percent above the 1940 level. It is to be noted that 1944 topped 1940 by just under 100 percent.

It is probably too early to say just how much of the capacity of the alkali plants will be excess in the postwar years. If we extrapolate the trend lines for these commodities, based on their 1929-1939 rates of growth, we find 1950 requirements for soda ash of about 4,200,000 tons; for caustic

soda of 1,900,000 tons; and for chlorine, of 1,300,000 tons. Actual capacity of the six ammonia-soda producers is not known. However, it is likely that a considerable part of the capacity that was used in 1944 and 1945 is old and outmoded. Further-

according to the trend, had it not been for the war. It seems unlikely, therefore, that there is any serious excess of capacity.

In the case of caustic soda any excess will probably be found in government plants and perhaps in lime-soda capacity. During the war the government built eight chlorine plants, not all equipped for complete caustic recovery, however. Several are now being offered as surplus. If we take lime-soda capacity as the 1945 output, namely, 715,000 tons, and total electrolytic caustic capacity at approximately 1,500,000 tons, it appears that total capacity may be slightly over 2,200,000 tons, perhaps 300,000 tons more than the projected 1950 demand.

For chlorine, especially, the case is complicated by changes in potential types of use, mainly expansion in uses in organic chemistry along a line that may well lie considerably above the trend. Privately owned plants increased from 40 to 51 during the war years, rising from a 1940 capacity of 800,000 tons to about 1,300,000 tons in 1944, roughly equal to the 1950 projected demand. Thus it might appear that the capacity of the government plants will be unneeded. Some of these plants, however, will be held as standby units against future emergencies. In addition the possibility of supra-trend expansion in chlorine needs should be given serious consideration. Various plastics, the silicones, certain synthetic rubbers, not to mention the chlorinated solvents and the well known prewar uses for chlorine may together conspire to push 1950 needs well above the private plant capacity that is available today.

Production of Caustic Soda in the United States

(Short Tons)			
Year*	Lime-Soda	Electrolytic	Total
1921.....	163,044	75,547	238,591
1923.....	314,195	122,424	436,619
1925.....	355,783	141,478	497,261
1927.....	387,235	185,182	572,417
1929.....	524,985	236,807	761,792
1931.....	455,832	203,057	658,889
1933.....	439,363	247,420	686,783
1935.....	436,980	322,401	759,381
1937.....	488,807	479,919	968,726
1939.....	532,914	492,132	1,025,046
1940 (est.).....	505,000	595,000	1,100,000
1941.....	685,999	743,316	1,429,315
1942.....	634,291	939,878	1,574,169
1943.....	663,495	1,034,577	1,700,072
1944.....	689,565	1,205,039	1,894,604
1945 (est.).....	715,000	1,110,000	1,825,000

* Figures for 1921-1943, except 1940, are from the U. S. Bureau of the Census. Prior to 1939 electrolytic caustic soda figures did not include that made and consumed at woodpulp mills, estimated at about 30,000 tons in 1927 and 1929, at about 24,000 tons in 1931, 21,000 tons in 1933, 20,000 tons in 1935, 17,000 tons in 1937, and 18,000 tons in 1939.

more, the industry normally operated in pre-war years at about 85-90 percent of rated capacity to allow for necessary down-time and maintenance. Allowing 10 percent for outmoded equipment and an equal amount for operating flexibility, it appears likely that present operating capacity of good equipment is less than the 3,700,000 tons which would have been required in 1946,

Estimated Distribution of Soda Ash Consumption in the United States

Consuming Industries	1943	1944	1945
	Short Tons	Short Tons (Revised)	Short Tons
Glass	1,200,000	1,290,000	1,320,000
Soap	150,000	162,000	140,000
Caustic and bicarbonate	1,010,000	1,033,000	1,076,000
Other chemicals	950,000	1,025,000	960,000
Cleansers and modified sodas ..	85,000	90,000	90,000
Pulp and paper	155,000	160,000	165,000
Water softeners	95,000	110,000	100,000
Petroleum refining	20,000	22,000	24,000
Textiles	58,000	61,000	68,000
Non-ferrous metals	450,000	340,000	220,000
Exports and miscellaneous	370,000	400,000	350,000
Totals	4,543,000	4,693,000	4,513,000

Estimated Distribution of Caustic Soda Consumption in the United States

Consuming Industries	1943	1944	1945
	Short Tons	Short Tons (Revised)	Short Tons
Soap	105,000	125,000	108,000
Chemicals	360,000	380,000	390,000
Petroleum refining	130,000	140,000	145,000
Rayon and transparent cellulose wrapping film	320,000	345,000	377,000
Lye and cleansers	100,000	110,000	100,000
Textiles	120,000	110,000	100,000
Rubber reclaiming	24,000	25,000	25,000
Vegetable oils	19,000	18,000	18,000
Pulp and paper	95,000	100,000	105,000
Exports and miscellaneous	496,000	530,000	460,000
Totals	1,769,000	1,883,000	1,828,000

Synthetic Organic Chemicals

Fastest Growing in War, Most Promising for Peace

THE SYNTHETIC organic chemical industry has emerged from the war period immensely bigger and more important than ever. Each year, production records have fallen while construction of new plants has progressed with amazing regularity and rapidity. Practically every branch of the industry participated in this phenomenal growth which continued in many instances right up to the war's end. While production of chemicals principally for direct or indirect military use suffered immediate cutbacks (such as toluene from petroleum), the bulk of the increased production capacity will be utilized for peace. Such materials as phenol, phthalic anhydride, acetic anhydride, methanol, formaldehyde and others will continue to be in great demand and, in some lines, further expansion is already being planned. Ingredients for aviation gasoline, however, particularly some of the special blending agents are already out since they cannot compete with tetraethyl lead in price. In contrast to so many industries, the transition from war to peace is primarily a reconversion to peacetime markets rather than to peacetime products.

While noncyclics continued their precipitous rise through 1944, they were closely paralleled by coal tar intermediates and finished products (note chart based on U. S. Tariff Commission figures and *Chem. & Met.* estimates). Even though the war's end in midyear 1945 had an immediate effect on production and plant construction, it is not likely that over-all production will be drastically lower than for 1944. Dye pro-

duction for 1945 is close to the 75,000 ton year 1944. A world leader in dvestuff manufacture, it has been predicted that U. S. producers will have an increasingly important share of the world market.

PETROLEUM CHEMICALS

Aside from the tremendous gains in production of synthetic organics in general, there are certain outstanding trends and developments worthy of note. Perhaps most significant is the strong movement toward greater utilization of petroleum and natural gas as basic raw materials for organic synthesis. Paced, during the war, by butadiene, toluene, and certain constituents of aviation gasoline, sharp activity in the production of nearly 200 organic chemicals, intermediates and crudes has given petroleum refineries a permanent stake in the industry. From less than 100,000 tons in 1942 to over 1,500,000 tons in 1944, excluding toluene, this branch of the industry can be counted a major factor in synthetic organics (see *Chem. & Met.* Dec. 1945, pp. 121-8).

Some of the most spectacular developments in organic chemistry in recent years have occurred in the field of chemotherapy. As often happens in wartime, progress in combating and curbing disease and disease-bearing insects was highly accelerated. Most outstanding, of course, is penicillin. Starting from scratch in 1943 the monthly production rate now approaches 700,000,000 Oxford units. Military needs have been met and it is now available in various forms for civilian uses. With high export demand,

market saturation will be a remote possibility for some time to come.

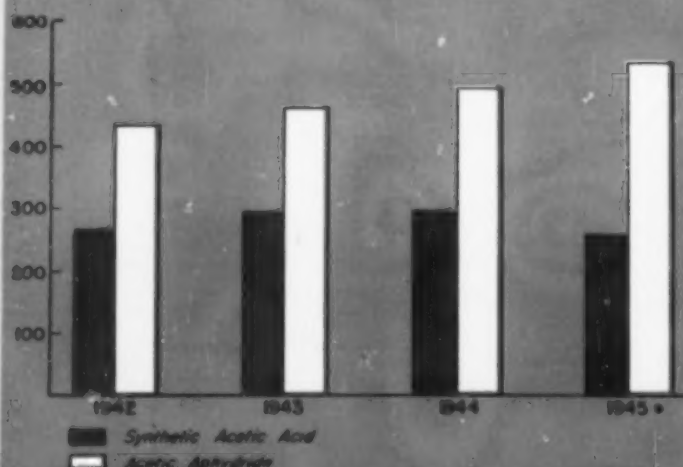
With equal import, another new wonder drug has made its appearance and may well parallel penicillin in growth. Isolated only in 1943, streptomycin shows great promise in killing disease organisms not destroyed by penicillin. Now undergoing a wide variety of tests it is being produced in pilot plant quantities only. At least eight firms, however, are either already expanding or are planning production facilities for a total monthly capacity of 300,000,000 units.

Insecticides too, have made similar strides, with DDT leading the way. Now available to the public in a number of different forms, DDT is being manufactured by some dozen commercial producers. Many other war developed insecticides, insect repellents, and fungicides will also take their place in the peacetime market.

NEW PROCESS

Topping off its remarkable growth during the war, phthalic anhydride, in 1945, wrote chemical engineering history. One of the most significant developments of recent years, the first successful application of fluid catalyst to non-petroleum processes was accomplished by the Sherwin Williams Co. to produce a 99 percent pure phthalic anhydride from naphthalene (see *Chem. & Met.* July 1945, pp. 100-1). Used extensively in the production of alkyd resins for protective coatings and plastics, insect repellents such as dimethyl phthalate, and plasticizers, most of the wartime capacity

PRODUCTION OF SYNTHETIC ACETIC ACID AND ACETIC ANHYDRIDE FOR 1942-1945



PRODUCTION OF CRUDE NAPHTHALENE AND PHTHALIC ANHYDRIDE FOR 1941-1945

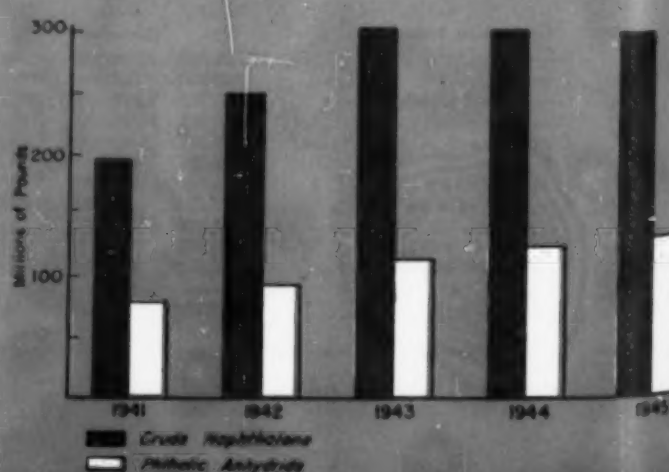


Table I—U. S. Production of Specified Synthetic Organic Chemicals¹

	1940	1941	1942	1943	1944
Acetic acid (100%).....	186,364,384	225,671,063	264,898,632	292,541,321	292,611,000
Acetic anhydride.....			430,363,880	460,425,849	495,522,000
Acetone.....	201,506,334			336,000,000 ²	384,814,000
Acetylsalicylic acid.....	6,409,824	8,084,003	8,170,113	8,687,773	9,423,000
Butyl acetate, normal.....			67,024,658	64,319,086	69,987,000
Ethyl acetate (85%).....	75,368,803	94,689,878	85,993,621	103,600,441	108,196,000
Ethyl ether.....		22,645,521	35,017,609	65,847,038	76,192,000
Formaldehyde (40%).....	180,884,573	277,000,000 ²	485,000,000 ²		522,440,000
Hexamethylenetetramine.....			15,332,993	24,733,192	18,309,000
Hydroquinone, photo.....	1,288,647	1,883,611	3,005,688	2,658,656	1,899,000
Isopropyl alcohol.....	219,925,900		380,000,000 ²		522,825,000
Methanol, (100%), gal.....	44,968,000	53,847,000	62,344,000	64,958,000	71,280,000
Methyl chloride (100%).....	3,041,661	4,911,360	4,557,597	11,451,086	24,299,000 ²
Methyl salicylate.....	1,641,571	2,577,601	2,250,124	2,724,945	3,412,000
Oxalic acid.....	12,921,227	15,851,200	15,110,276	17,149,798	18,027,000
Phthalic anhydride.....	58,000,000		94,807,180	113,067,286	124,063,494
Plasticizers, non-coal-tar..	8,474,052	12,118,032	25,032,829	49,724,215	26,510,000
Salicylic acid.....	5,068,010	5,326,080	4,131,483	5,124,133	5,469,000
Sulfur drugs, total.....			5,434,427	10,005,307	4,514,000

¹ From U. S. Tariff Commission and Bureau of Census. All figures are given in pounds except where otherwise noted. ² Approximated by Chem. & Met. ³ All grades

Table II—U. S. Production of Coal-Tar Synthetic Organic Chemicals¹

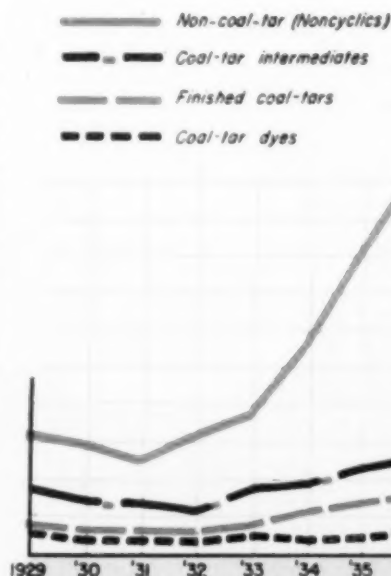
	1938	1939	1940	1941	1942	1943	1944
Intermediates.....	401,943	607,175	805,807	1,006,564	1,230,965	1,637,275	2,189,343
Dyes.....	81,759	120,191	127,834	168,595	151,878	144,013	151,651
Color lakes and toners.....	14,407	18,154	19,213	26,278	17,176	16,317	18,262
Medicinals.....	11,097	15,188	18,214	29,775	35,318	51,633	38,424
Flavors and perfumes.....	3,837	5,349	5,485	9,931	7,947	9,559	11,796
Rubber chemicals.....	18,771	29,966	37,139	40,575	34,235	61,710	74,110
Miscellaneous.....	39,593	69,681	92,023	155,069	227,809	320,679	451,825

¹ As thousands of pounds. Data from U. S. Tariff Commission.

should be readily absorbed by expanding peacetime requirements.

One of the big question marks in the chemical industry is synthetic rubber. However, economic considerations have already forced alcohol out of the synthetic rubber picture and only petroleum sources of butadiene will be continued. For the next year it has been estimated that synthetic production will reach about 900,000 tons, one third of which may be exported. Estimated receipts of natural rubber are in the neighborhood of 300,000 tons. While major cutbacks appear on the alcohol side of the picture, significant changes will also occur in the chemicals used in rubber manufacture. Already there is an oversupply of antioxidants such as dibutyl phthalate and many other of the organic rubber-processing chemicals are in the same situation. As the shift to natural rubber increases, the same shift will be felt by the manufacturer of rubber chemicals. Displaced items in this class are expected to find new uses and many of them have already been placed on the general market.

U. S. PRODUCTION OF SYNTHETIC ORGANIC CHEMICALS



Fertilizer Materials

Face Almost Unlimited Demand To Aid Farm & Food Production

PRODUCTION and use of fertilizers in the United States continues at peak levels, limited principally by scarcity of raw materials. That scarcity is world-wide, amounting to a shortage of 300,000 tons of nitrogen, 500,000 tons of P_2O_5 , and 175,000 tons of K_2O for the present crop year. The shortage in the United States is caused more by difficulty in getting labor and freight car transportation than by any other characteristics inherent in the business of producing those raw materials.

Sales of mixed fertilizer during the present fertilizer year are expected to amount to approximately 9.5 million tons; and the supply of fertilizer materials for separate use will be about 3 million tons, of which nearly two-thirds will be superphosphate. There is no doubt but that larger tonnages of both classes would have been made and promptly used for farm distribution had there not been scarcity of materials. But such greater consumption would probably have been largely through government distribution for soil conservation purposes. In other words, the supply of fertilizer for direct purchase

by farmers has been about in balance with demand.

Potash for fertilizers is currently being used at an all-time high rate. This is possible because of increased production (about 10 percent above last year) and by a small decline in requirements for potash in the chemical industries. The fertilizer use would be still higher than now were not many thousand tons held up at points of production by inability to get freight cars.

IMPORTS OF POTASH

United States imports of potash have been less than exports. It is not expected that any imports will come from Europe or the Near East until the needs of those and other hungry areas of the Eastern Hemisphere can be more nearly met, since the amount of fertilizer used may largely determine speed of recovery in crop production. At the present time the Joint Food Board which largely governs international food policies is treating the Eastern Hemisphere and Western Hemisphere as though

they were two independent areas which will not trade in potash.

Nitrogen supply for industrial and agricultural purposes in the United States might appear to be more than adequate because the factory capacity to make synthetic ammonia greatly exceeds total demand for nitrogen compounds. Unfortunately, this appearance of plenty does not reflect the facts. Much of the synthetic capacity is and will be idle because there is no way quickly available to transform the ammonia there made into usable compounds of the sorts required for farm and chemical uses.

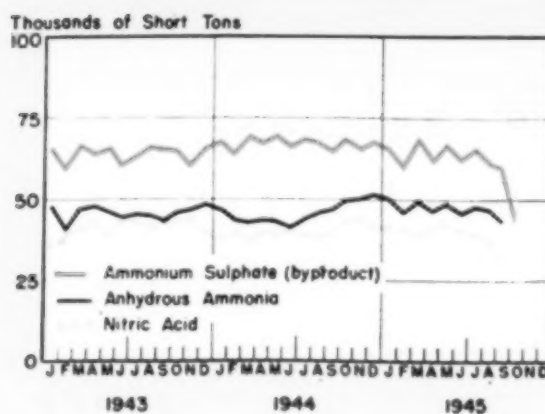
Thus operations of 1946 are bound to bring scarcity of ammonium sulphate and ammonium nitrate, as well as inadequate supply of Chilean nitrate, despite surplus of fixed nitrogen as anhydrous ammonia. Under these circumstances every superphosphate producer is anxious to use as much as possible of nitrogen compounds for ammoniation, thus converting surplus free ammonia into usable fixed forms.

NITROGEN CONSUMPTION

Nitrogen consumption will suffer under these circumstances from scarcity for both mixed fertilizer and the chemicals used separately for top dressing and side dressing. The shortage may be most serious in the case of separate-use chemicals because Chilean nitrate is not coming into this country currently at more than two-thirds the rate which prevailed during the last war year. The government no longer offers a subsidy on this chemical by absorbing \$5 or more of excess transportation cost.

Superphosphate which is the major tonnage component of mixed fertilizer is being produced at an all-time peak rate. More would be made if both more phosphate rock and more sulphuric acid could be had at acidulating works. Shutdown of Army arsenals caused a brief scarcity of acid but prompt reopening of certain acid facilities has brought rock supply and acid supply sharply about in balance.

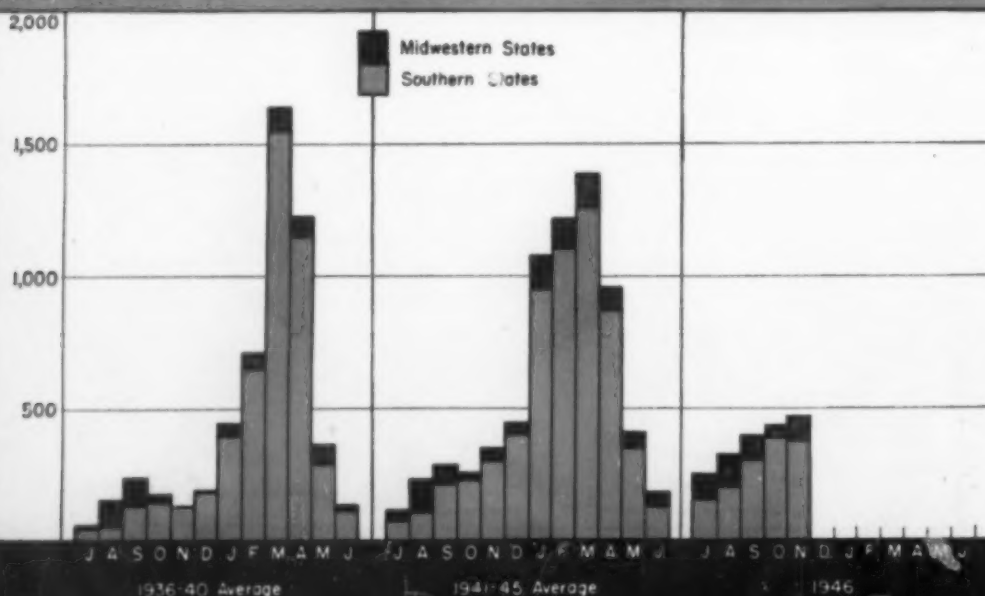
NITROGENOUS PRODUCTS



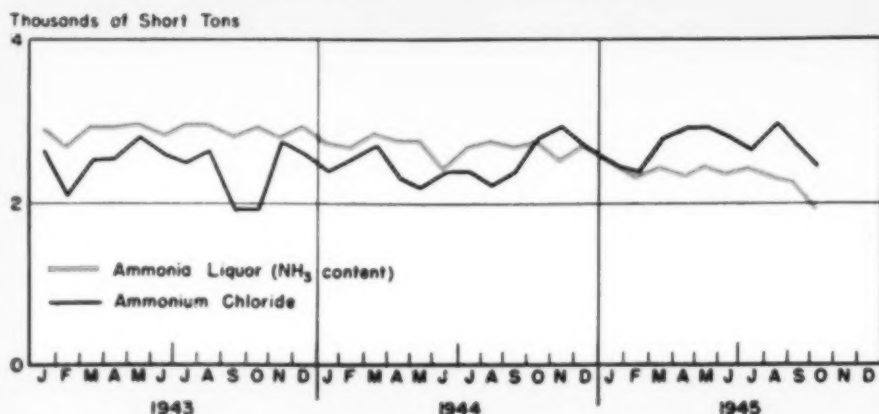
MONTHLY FERTILIZER TAX TAG SALES

Years Ended June 30

Thousands of Short Tons



PRODUCTION TRENDS (Excluding Ordnance)



A major economic problem of the entire industry, and the material suppliers as well, has been the question of government interference with private enterprise. During the past year a group disposed to favor government participation in business drafted the S. 882 bill. That measure would have established government-owned potash and phosphate works in the west with promise that these factories should ultimately be disposed of to farm cooperatives for operation in competition with privately-owned establishments. There seems at the New Year little chance that this bill as originally drafted will ever get serious further development in Congress. But the public ownership group, though potentially suppressed, have not lost hope. And S. 882 may be made the vehicle of some comprehensive legislation during 1946. However, there seems to be no doubt that the more drastic features of the original bill are dead.

Sales of fertilizer tax tags for the first four months of the current fertilizer year ran close to 30 percent ahead of those for the comparable period of 1944-45. While a good part of such sales was intended to provide a fertilizer supply for all application, the buying movement continued through the latter part of the year against the normal seasonal trend. Difficulty in securing ample supplies in the last two or more years has altered buying habits and established a trend toward early buying even though this means that consumers must provide storage space for the material. Early delivery for spring consumption proved popular last year and apparently is gaining further momentum this season.

FARM INCOME

The sharp rise in fertilizer consumption during war years of course was due most directly to the urgency of carrying out the war food program. However, an additional incentive was found in the rising curve of farm income and it is the latter which is given most consideration in attempting to

forecast the rate of activity within the industry for the next few years. Surveys made by the Department of Agriculture would indicate that farm income will drop in 1946 anywhere from 10 to 15 percent. This does not mean that a corresponding decline will be registered in the fertilizer industry. The beneficial results obtained through larger use of fertilizer has been of considerable educational value which may go a long way in offsetting any moderate decline in the value of farm products.

Cash receipts from farm marketings closely followed the curve of income for employees in industry from 1920 to 1940 but fell behind in the war period although the lines were drawing closer in the latter part of last year. It is probable that the prewar relationship will be established in the nearby future and as workers in industry will be compensated at levels much above the prewar standards, it may reasonably be inferred that farm income will move in a similar way, all of which points to a new normal for fertilizer production and consumption in the postwar period.

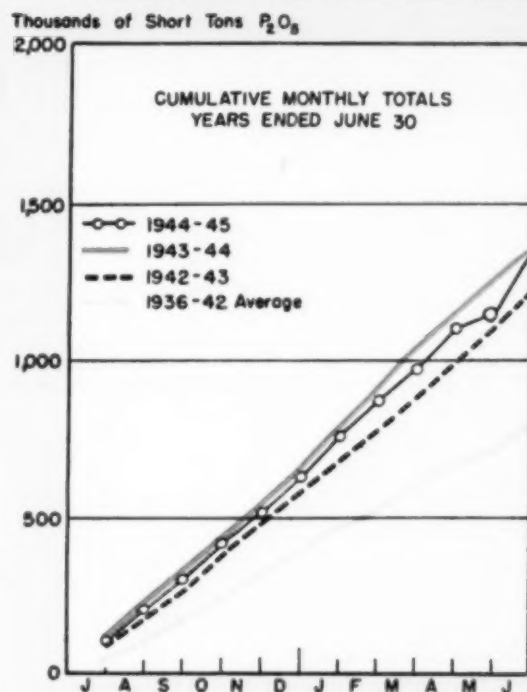
PRICE SUPPORTS

The Department of Commerce recently pointed out although it is generally believed that the current rate of agricultural production, which it placed at 32 percent above the prewar average, will in most cases exceed domestic civilian consumption at wartime prices, the only notable decline in prices for farm products has occurred in truck crops.

It is further asserted that prices received by farmers currently averaged about 14 percent above parity. Government price support is a prominent factor in maintaining prices as many agricultural products are supported either by purchase or by loan guarantees. Such price support may be used more extensively in the future since legislation provides a price floor at 90 percent of parity for a wide variety of commodities for two complete years after the formal cessation of hostilities.

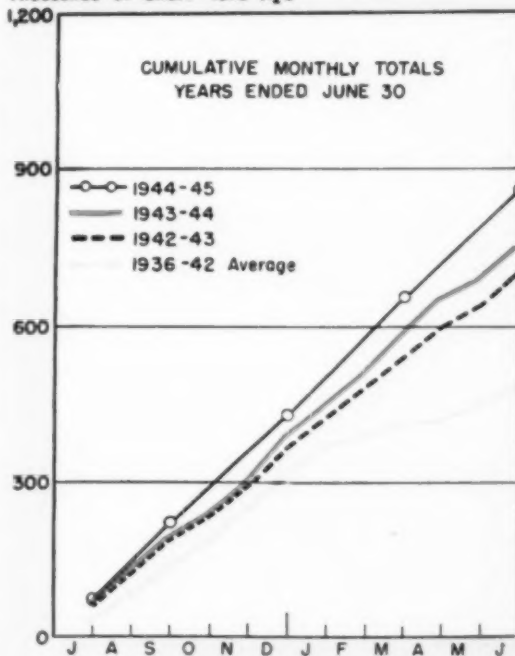
SUPERPHOSPHATE PRODUCTION

(Including concentrated and wet base goods)



DOMESTIC POTASH DELIVERIES

Thousands of Short Tons K_2O



Fertilizer Tax Tag Sales

(Expressed as Tons)

	Nov., 1945	Jan.-Nov., 1945
Virginia	37,161	568,877
North Carolina	63,291	1,332,047
South Carolina	34,150	759,410
Georgia	58,142	1,047,844
Florida	100,703	817,173
Alabama	20,350	485,050
Mississippi	15,250	352,807
Tennessee	6,388	273,570
Arkansas	750	114,150
Louisiana	10,580	224,010
Texas	23,343	215,198
Oklahoma	2,000	24,312
Total South.....	372,028	6,415,268
Indiana	79,591	488,197
Illinois	12,650	231,144
Kentucky	8,650	270,796
Missouri	770	147,404
Kansas	1,005	37,620
Total Midwest.....	102,666	1,175,181
Grand total.....	474,694	7,590,449

PLASTICS and RAYON Prepare For Peacetime Progress

THE war years saw a tremendous growth in the plastics industry reaching an all-time production rate of 900,000,000 lb. per yr. on V-J Day. Since that time there has been some slowing down due to labor shortages which caused the production figures for the year to be slightly below those of the previous year. Large-scale use of vinyl resins was started at the beginning of the war and has increased steadily until the sales volume was the largest for any plastics material in 1944 with vinyl chloride the largest production item in the group, according to the

Bureau of Foreign and Domestic Commerce. In the final full war year, 1944, protective coatings led all other applications for synthetic resins. This use required 293,000,000 lb. The other uses in the descending order of importance were for moldings and castings, for miscellaneous uses and adhesives, for laminating, and for treatment of textiles, paper and leather.

The outlook for the industry is extremely promising the Plastics Materials Manufacturers' Association announces after surveying its membership. A conservative estimate of the plans of the association members alone is that new facilities for production of plastic materials will entail expenditures amounting to \$107,000,000 during 1946 and the early part of 1947. A major portion of these new facilities will be for the production of molding materials.

Expansion of facilities for producing phenolic molding materials now pending, and in some cases already started, will permit a 42 percent increase over present capacities during the early part of 1947. Expansions in urea and melamine molding powder production to become effective during the latter part of 1946 or early 1947 will permit production at a rate 80 percent higher than current levels. New facilities for the manufacture of cellulose ester flake and molding materials to be completed by July 1947 will provide capacity 53 percent in

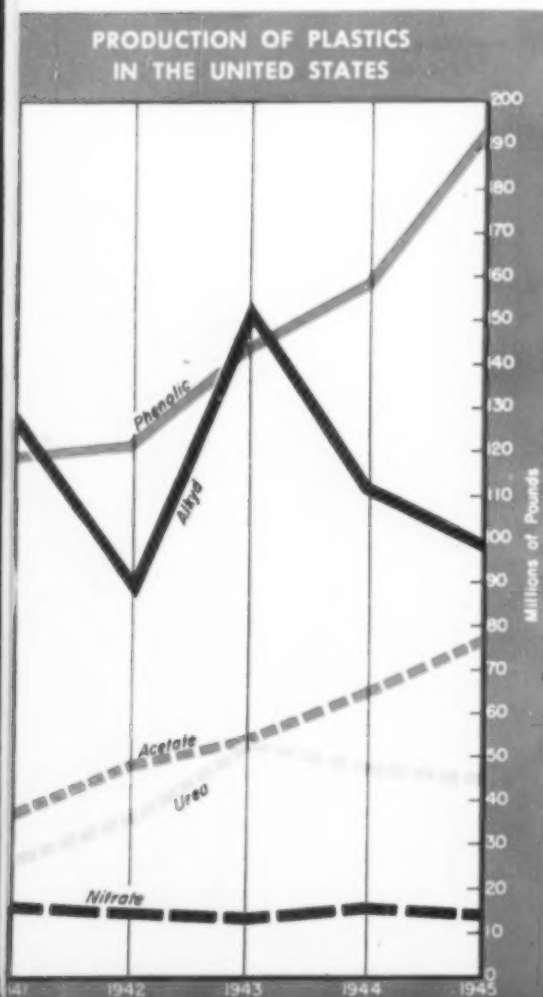
excess of the present production facilities.

Long range expansion of facilities for making polystyrene molding powder may permit production of a 600 percent increase based on present operation. This appears to be the largest expansion program for any given plastic material now under consideration.

It is anticipated that substantial increases during the first quarter of 1946 may increase the present supply of acrylic molding powder by 20 percent. Ethyl cellulose molding material capacity may be increased by the first quarter of 1947 by 36 percent of the present supply. Anticipating future requirements of polythene and nylon molding materials manufacturers will have greatly enlarged capacities available during the first quarter of next year.

Over the long term, it is anticipated that compounding capacity for vinyl resins will be increased by over 100 percent. In the early part of 1947 the volume of vinylidene chloride plastic production will be about 450 percent of the 1944 rate. Customers can anticipate increased availability of cellulose acetate continuous sheeting during the fourth quarter of 1946 and through July 1947 amounting to 66 percent increase over the present rate.

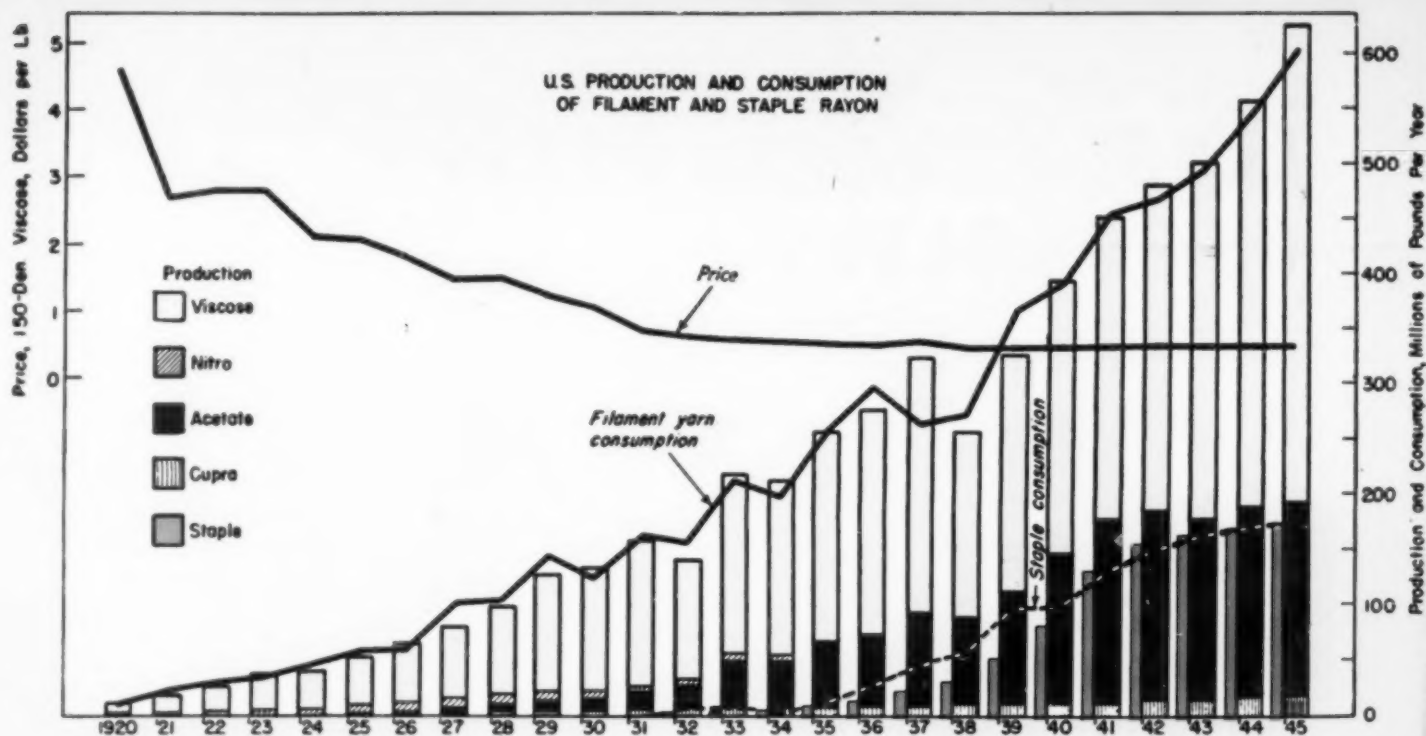
The last basic patent in the phenol-furfural resin field is expiring early in the year.



Plastic Production

Year	Acetate	Nitrate	Phenolic	Urea	Alkyd
1945	77,000,000*	15,000,000*	193,000,000*	45,000,000*	100,000,000 lb.*
1944	65,023,000	15,951,000	158,944,000	47,972,000	112,685,000 lb.
1943	54,386,000	14,042,348	144,541,000	53,859,000	154,385,000 lb.
1942	48,246,000	15,128,826	122,440,978	37,515,785	91,237,362 lb.
1941	37,100,745	16,497,019	119,500,000*	28,780,000*	128,362,566 lb.

*Chem. & Mat. estimate



RAYON

IN MORE than one textile field, 1946 may be expected to introduce the "battle of the fibers" that writers on the man-made textile raw materials have been predicting for several years. Most interesting to watch, perhaps, will be the competition between the cellulose-derived and the non-cellulose materials, where the polyamides and the vinyls will be off to a considerable start as compared with other synthetics, but will encounter terrific competition from the already established cellulose-based materials. Then there will be the competition between cotton and rayon, for example in the field of tire cord, and doubtless an attempt on the part of silk to re-establish itself in its lost American markets. Just getting under way before the war, the sheeted, non-woven plastic substitutes for textiles, that are used for such purposes as rain coats and shower curtains, may be expected to increase strongly their bid for markets of this character.

Rayon and nylon were lifesavers in the United States during the war as they were to some extent in every other warring country except Russia. World figures for 1945 are not available but estimates for every year through 1944 have been presented by Rayon Organon, showing sharp increases in most of the involved countries, either during the war or immediately before it. In the Axis countries and Japan, for example, the increases came in the immediate prewar years and it is further significant that the increases were generally more marked in staple than in filament yarns—indicating the production of wool substitutes for uniforms. In the United States the increase from 1940 to 1945 amounted to 60 percent for filament yarns, and to 110 percent for staple, but

the actual quantity increase for the latter was only 90,000,000 lb., as compared with 235,000,000 lb. for the former.

Final 1945 figures are not available as this is written, but based on the production for the first three quarters plus consumption data through November as reported by the industry's official data outlet, Rayon Organon, we estimate a total production for 1945 of 796,000,000 lb. of rayon (not including nylon and other non-cellulose based yarns), made up of 625,000,000 lb. of filament yarns and 171,000,000 lb. of staple fiber. Of the filament total, 434,000,000 lb. is believed to have been viscose, 175,000,000 lb. acetate and 16,000,000 lb. cuprammonium. Estimates of the staple breakdown put the viscose total at 132,000,000 lb., with 39,000,000 lb. of acetate staple.

Despite the large wartime increase in

rayon production in the United States, there was no increase in rayon for civilian use. In fact, quite the reverse was true, for the bulk of the increased capacity of filament yarns was for tire cord, all of which was designated for military use until recently, while a considerable portion was earmarked for export, silk and nylon replacement, and military needs such as fragmentation bomb and aerial delivery parachutes. For example, tire yarns alone are estimated by the Organon to have amounted to 28,400,000 lb. in 1942; 55,600,000 lb. in 1943; 115,200,000 lb. in 1944; and 137,200,000 lb. for nine months of 1945 (or perhaps 185,000,000 lb. for the year). With many capacity increases projected (to 291,000,000 lb. of tire yarn, for example) there should be no difficulty in supplying all demands for the near future.

**U. S. and World Production of Rayon Filament Yarns and Staple Fiber
(1,000 lb. Units)**

Year	FILAMENT YARNS			STAPLE FIBER	
	U. S. Production	U. S. Export Balance ¹	World Production	U. S. Production	World Production
1922	24,065	-2,116	76,590		
1923	34,960	-3,029	102,990		
1924	36,330	-1,954	138,285		
1925	51,050	-5,293	185,290		
1926	62,695	-8,945	211,735		
1927	75,555	-14,633	295,095		
1928	97,230	-11,948	360,550		
1929	121,400	-14,832	434,215		
1930	127,335	-5,995	451,200	500	7,165
1931	150,880	-1,490	499,665	350	6,250
1932	134,670	456	517,300	880	7,980
1933	213,500	176	663,395	1,100	17,285
1934	208,320	2,432	772,525	2,100	27,895
1935	257,555	2,193	941,055	2,200	51,835
1936	277,640	1,558	1,023,305	4,600	139,575
1937	321,680	525	1,203,105	12,300	298,595
1938	257,625	1,195	991,475	20,245	620,955
1939	328,625	1,703	1,150,425	29,860	959,735
1940	390,070	1,440	1,183,760	51,315	1,149,440
1941	451,205	1	1,267,025	81,100	1,279,700
1942	479,330	5,600	1,213,170	122,025	1,492,080
1943	501,125	9,500	1,165,885	153,285	1,536,985
1944	555,215	16,300	1,039,630	162,020	1,467,350
1945	625,000 ²	23,000 ²	1	168,740	1,116,910

Data from Rayon Organon except as indicated.

¹Minus indicates net imports.

²Data unavailable. ³Chem. & Met. estimate.

ALCOHOL MEETS HEAVY WAR DEMANDS

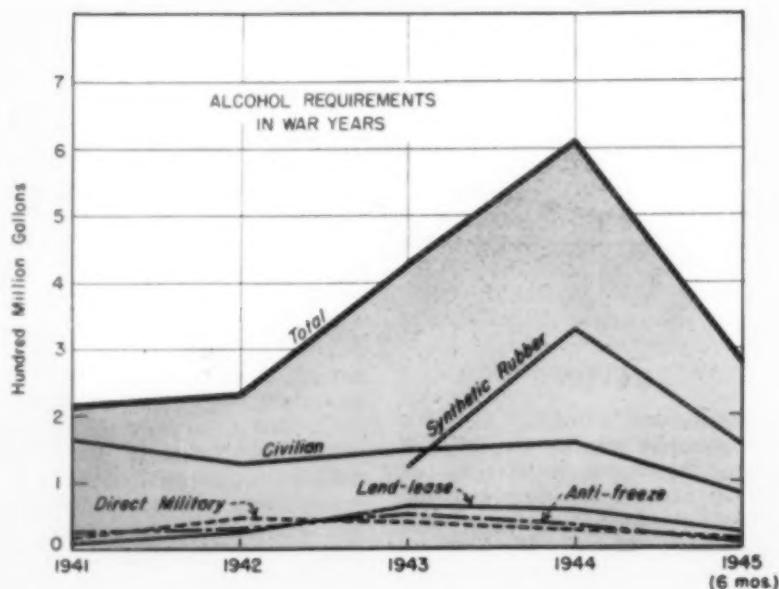
ETHYL ALCOHOL was one of the first chemicals to feel the effects of war-time influences. In 1940 as our defense program began to take definite shape it became evident that large amounts of alcohol would be required, particularly for the manufacture of smokeless powder. Later when our defense program was succeeded by all-out production for war the importance of alcohol was still further demonstrated when it became the cornerstone upon which the synthetic rubber industry was erected.

Just how useful and how necessary alcohol was in the last four years may be measured very definitely by the figures of production and consumption. Normal demands, if we take 1939 as representative, were 104 million gallons, all of which was for civilian use. This increased to 130 million gallons in the following year and while it was described as for civilian use, a good part of the increase went into the making of smokeless powder. From then on through the first eight months of 1945 the trend was upward. The peak was reached in 1944 when production amounted to 569 million gallons to which 33 million gallons of imported alcohol was added to give a total supply of 602 million gallons. Considerable of the pressure had been removed by 1945 and production schedules were modified but actual output for the first half of the year was 220 million gallons or more than twice the prewar normal requirements for a complete year.

MATERIALS USED

In the prewar era, production of alcohol depended largely upon molasses as a raw material with a younger synthetic branch becoming increasingly important each year. The changes in production methods and in the raw materials used are made clear by comparing the data for 1939 and 1944. In the former year, the 103 million gallons produced came, 69 million from molasses, 25 million from synthetic production, and 9 million from grain. In 1944, grain supplied 359 gallons, molasses 150 million, and synthetic producers 60 million. By 1945 the use of grain was restricted and the first six months of operation saw the bulk of alcohol production again coming from molasses.

Under the stress of war needs the important thing was to turn out alcohol in the amounts required. All resources had to be put to work even though economic factors had to be disregarded. Hence the facilities of liquor distillers were called upon and



from that source we produced 120 million gallons in 1942, 228 million gallons in 1943, 225 million gallons in 1944, and 80 million gallons in the first half of 1945.

On the consuming end the largest outlet for alcohol was in the manufacture of butadiene for synthetic rubber. Sharing this responsibility with the petroleum industry, the greater load fell on alcohol because the product of oil refineries was more urgently needed for aviation gasoline. In December, three government plants were ordered to cease making butadiene from alcohol. This

will free larger amounts of alcohol for use in regular civilian lines.

In considering the postwar situation, it must be considered that the huge expansion in productive capacity came from expansion of existing plants and the temporary expediency of utilizing distilleries. The 19 new plants accounted for a combined total of 80 million gallons and these plants were equipped for use of grain as the raw material. With the removal of subsidies and an open market for raw materials, economic phases of production will again become paramount.

Supply and Consumption of Ethyl Alcohol
Millions of Gallons

	1939	1940	1941	1942	1943	1944	1945
Supply							
Synthetic	25	32	43	50	56	60	29
From molasses	69	86	143	114	81	150	191
From grains	9	8	31	133	300	359	...
Imports	...	...	...	1	12	33	15
Total	103	126	217	298	449	602	235
Consumption							
Direct military	...	...	18	46	40	27	15
Lend-Lease	...	...	9	25	63	60	23
Synthetic rubber	...	...	...	...	126	330	155
Anti-freeze	...	...	23	30	51	32	9
Indirect military and civilian	104	130	165	128	148	160	81
Total	104	130	215	229	428	609	283

NAVAL STORES SUPPLIES DECLINE

PRODUCTION of gum rosin and turpentine for the crop year to date has not varied much from that for the comparable period last year. As the outturn for 1944-45 crop year was the lowest on record in recent years, it is evident that the industry has staged little if any recovery. Data recently released cover operations for the first half of the current naval stores year and show that the wood branch of the industry although hampered by shortage of labor and other difficulties, managed to register gains

in the production of both turpentine and rosin. Moreover plans have been made for expanding capacity for producing wood rosin and turpentine.

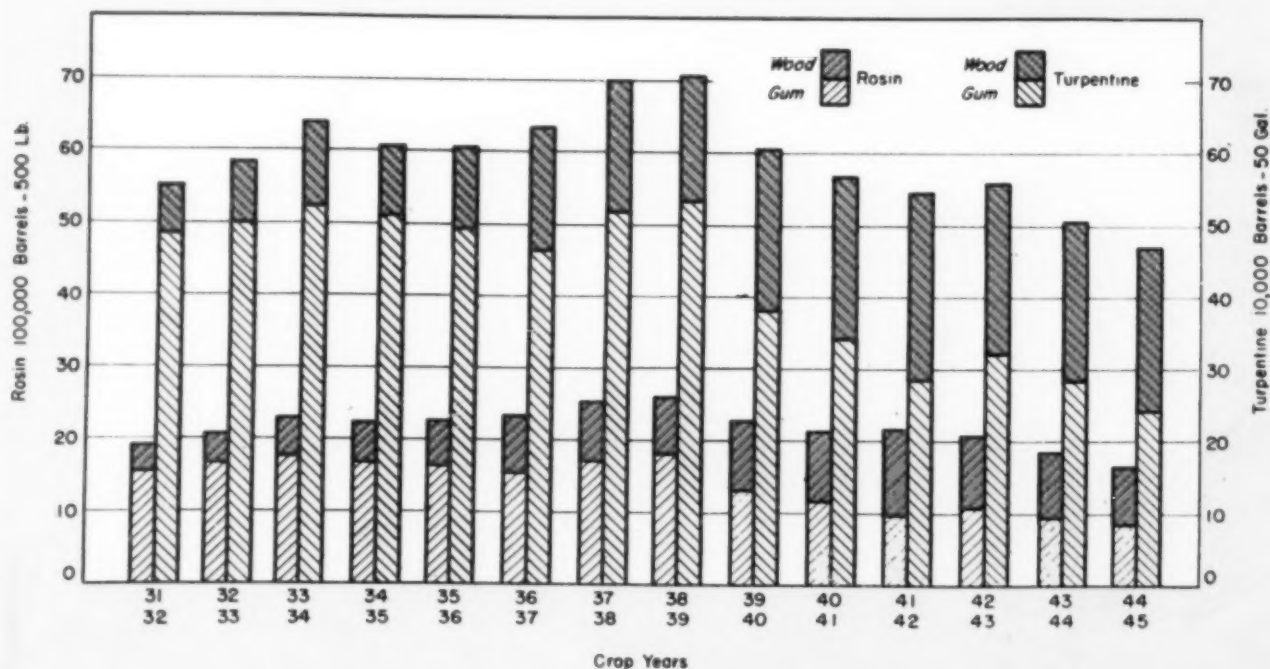
However, a tight situation exists for naval stores products with no material relief in immediate prospect. Export inquiry for rosin has increased and estimates are that production in 1945 will run some 80,000 drums less than the quantity on which present quotas are established. The shortage in rosin supplies is not evenly distributed

throughout the grades, and this is forcing consumers to take on less desirable grades despite difficult interchangeability.

The conservation program which has been in effect for some time will be continued through 1946 though the appropriation has been reduced which caused some modifications chief of which is the reducing of payments for each working face from 14 cents to 1 cent. Also it was expected that new ceiling prices for turpentine soon would be established.

Supply and Distribution of Turpentine and Rosin

	Turpentine, 50-Gal. Bbl.						Rosin, 500-Lb. Bbl.					
	April-September, 1945			April-September, 1944			April-September, 1945			April-September, 1944		
	Total	Gum	Wood	Total	Gum	Wood	Total	Gum	Wood	Total	Gum	Wood
Carryover, April 1...	202,546	168,011	34,535	295,581	262,057	33,524	388,266	265,881	122,385	794,786	648,206	146,580
Production.....	281,124	158,981	122,143	269,439	159,312	110,127	774,481	431,055	343,426	728,736	426,310	302,426
Imports.....	8,896	8,896	.....	8,390	8,390	.....	9,326	9,326	.....	2,578	2,578	.....
Available supply.....	492,566	335,888	156,678	573,410	429,759	143,651	1,172,073	706,262	465,811	1,526,100	1,077,094	449,006
Carryover, Sept. 30.....	165,326	123,460	41,866	258,443	233,151	25,292	473,146	325,937	147,209	661,594	526,639	134,955
Apparent total consumption.....	327,240	212,428	114,812	314,967	196,608	118,359	698,927	380,325	318,602	864,506	550,455	314,051
Exports.....	51,146	42,032	9,114	43,735	35,508	8,227	64,678	30,272	34,406	145,343	120,084	25,259
U. S. consumption.....	276,094	170,396	105,698	271,232	161,100	110,132	634,249	350,053	284,196	719,163	430,371	288,792



WORLDWIDE SHORTAGE OF OILS AND FATS

OUTPUT of fats and oils from domestic materials in 1945 totaled about 9.5 billion pounds, 1.3 billion pounds less than in 1944. The effect of this on the civilian supply was moderated in early 1945 by relatively large stocks of lard, linseed oil, and other fats on hand at the beginning of the year. By midyear, stocks were near minimum working levels. Scarcities reached their most acute stage in the late summer. A seasonal increase in production of lard and oils in the fall, together with cutbacks in military procurement, brought moderate relief to civilian users.

Exports to our Allies continued large in the first half of 1945, but were sharply reduced in the fall, chiefly because of short supplies. Imports arrived in the smallest volume in many years, in part as the result of diversion of export supplies in surplus areas to Europe. Net exports totaled about 300 million pounds, compared with 650 million pounds in 1943 and 1944. In 1937-

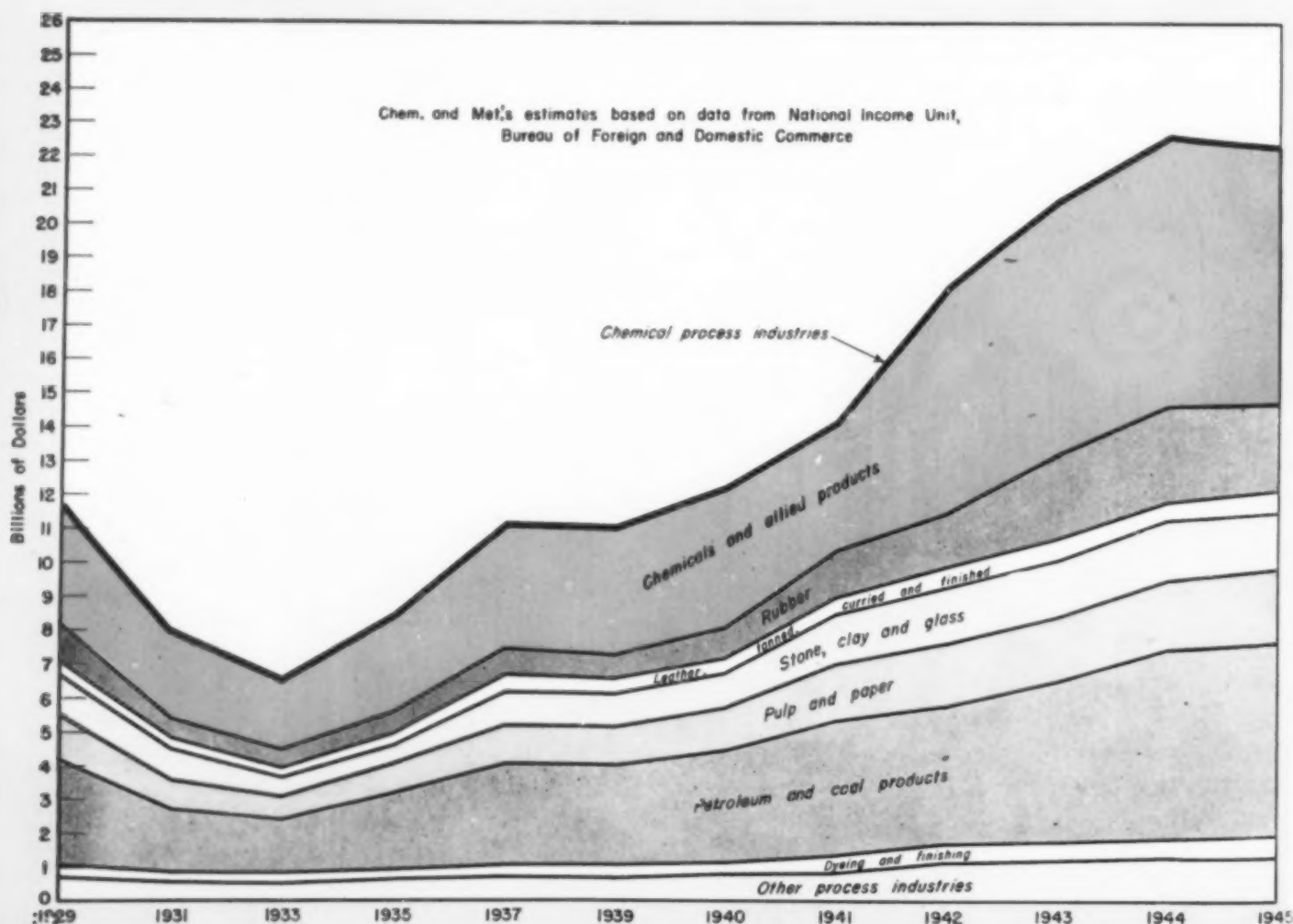
41, the United States had an average net import balance of approximately 1,500 million pounds annually, with imports consisting chiefly of soap fats, drying oils, olive oil, and fish-liver oils.

Production of fats and oils from domestic materials may be slightly larger in 1946 on the basis of present crop and livestock indications. Production of linseed oil from domestic flaxseed will be materially greater in the first half of 1946 than the unusually low output in the first half of 1945, as a result of an increase of over 50 percent in flaxseed production. The larger crop of soybeans in 1945 will result in some increase in soybean oil output in 1946, but this probably will be limited, because larger quantities of soy beans will be exported. On the other hand, production of cottonseed oil will be substantially smaller in the first half of 1946 than a year earlier, because of a reduction of about 20 percent in the cotton crop.

Any major increase in domestic supplies of fats in 1946 must come from imports. Moderately larger quantities of South American flaxseed will be available. In addition, some Philippine copra will be imported, and tung oil from China probably will become available in some volume. Exports of fats and oils from the United States will be smaller than in 1945; the United States may have a net import balance in fats and oils for the first time since 1941.

Supplies of fats and oils available in 1945 to the United States and Europe from other parts of the world totaled approximately 4.3 billion pounds compared with about 9.6 billion pounds in prewar years. This reduction was due principally to loss of supplies from Asia, including the Philippines and the Netherlands Indies, and to curtailment of whaling in Antarctic waters. There also were substantial reductions from prewar in the quantity of oilseeds and oils available from Africa and South America.

VALUE OF OUTPUT, PRESENT AND PAST INDUSTRIES



AWARD FOR CHEMICAL ENGINEERING ACHIEVEMENT

TO GO TO

Atomic Bomb Project



By unanimous vote of the Committee, the seventh biennial Award for Chemical Engineering Achievement goes to the Atomic Bomb Project—particularly to those companies, educational and research institutions that as prime contractors of the Manhattan Engineer District have contributed most significantly to the scientific and engineering phases of this history-making development. Approximately a hundred organizations have been so designated and each will receive an appropriate scroll of award at a dinner of the chemical engineering profession in New York during the forthcoming Chemical Exposition.

WHEN THE Award for Chemical Engineering Achievement was founded in 1933, its primary purpose was to recognize group effort—particularly the sort of industrial achievement that results from teamwork between science and engineering. Because the important but sometimes less spectacular role of the chemical engineer in these developments is not always appreciated, especially by the layman, this award has also served to focus public attention on those companies that have encouraged their chemical engineers to participate broadly in all of the affairs of their industries.

The first of these biennial awards was voted to the Carbide and Carbon Chemicals Corp. for its pioneering development of synthetic organic chemicals from petroleum and natural gas. The second went to the Organic Chemicals Department of E. I.

du Pont de Nemours & Co. for producing synthetic rubber from acetylene and camphor from American turpentine. The third

The Seventh Award for Chemical Engineering Achievement will be presented with appropriate ceremonies at a dinner in the grand ballroom of the Waldorf-Astoria Hotel in New York City on Tuesday, February 26. Members of the chemical engineering profession are cordially invited. For further information on tickets and table reservations, address Manager Award Dinner, Room 2401, 330 West 42nd Street, New York 18, N. Y.

award was to the Monsanto Chemical Co. for the large-scale production of elemental phosphorus as the basis for a new heavy chemical industry and the fourth went to the Standard Oil Development Co. for its development of synthetic aviation fuels and related products from petroleum. In December, 1941, the Dow Chemical Co. received this recognition for the recovery of metallic magnesium from sea-water. All of these were outstanding achievements, not of individual scientists or engineers, but of closely-knit coordinated groups in which chemical engineering played an important role.

In 1943, with American industry mobilized for war production, the Committee of Award was faced with a difficult problem. It was patently impossible for it to single out the achievements of any individual company since many were engaged in research

Committee of Award for Chemical Engineering Achievement

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Professor Emeritus, Department of Chemical and Metallurgical Engineering, University of Michigan, Ann Arbor, Mich.

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RICHARD L. HUNTINGTON, University of Oklahoma, Norman, Okla.

GEORGE W. GLEESON, Oregon State College, Corvallis, Ore.

DONALD S. CRYDER, Pennsylvania State College, State College, Pa.

MELVIN C. MOLSTAD, University of Pennsylvania, Philadelphia, Pa.

JAMES COULL, University of Pittsburgh, Pittsburgh, Pa.

DONALD F. OTHMER, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

JOSEPH C. ELGIN, Princeton University, Princeton, N. J.

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HOWARD S. GARDNER, University of Rochester, Rochester, N. Y.

CHARLES D. LUKE, Syracuse University, Syracuse, N. Y.

ROBERT M. BOARTS, University of Tennessee, Knoxville, Tenn.

EUGENE P. SCHOCH, University of Texas, Austin, Tex.

J. HENRY RUSHTON, University of Virginia, Charlottesville, Va.

FRANK C. VILBRANDT, Virginia Polytechnic Institute, Blacksburg, Va.

HENRY K. BENSON, University of Washington, Seattle, Wash.

OLAF A. HOUGEN, University of Wisconsin, Madison, Wis.

ERNEST D. WILSON, Worcester Polytechnic Institute, Worcester, Mass.

BARNETT F. DODGE, Yale University, New Haven, Conn.

and development work that could not be revealed for reasons of national security. Happily the committee, which comprises the heads of chemical engineering in all of the educational institutions accredited by the American Institute of Chemical Engineers and the Engineers Council for Professional Development, found a fitting solution for its problem by according recognition to all the companies that contributed to the nation's outstanding chemical engineering achievement of that period—the successful development of the American synthetic rubber industry. The presentation dinner held in the Waldorf in New York on December 8, 1943, was a memorable occasion with almost 2,000 in attendance. (See *Chemical & Metallurgical Engineering*, Nov. 1943, pp. 95-108, and Dec. 1943, pp. 96-101.)

This year the Committee, faced with a similar choice, has voted unanimously to

present the Seventh Award for Chemical Engineering Achievement to the Atomic Bomb Project—particularly to those companies and educational institutions that have contributed significantly to the research and engineering responsible for the success of this tremendous undertaking. The one organization that ties together all of the manifold activities connected with this project from almost its conception to its completion is the Manhattan Engineer District of the War Department. Its prime contractors include the various organizations responsible for the scientific research and laboratory development, the pilot plant and experimental engineering, the design, construction and operation of the plants and finally the assembly and testing of the finished products of this \$2 billion enterprise. Sharing with the Manhattan District and these prime contractors are literally tens of

thousands of sub-contractors representing a broad cross section of practically the whole of American industry.

With the cooperation of Major General Leslie R. Groves, commanding general in charge of the Manhattan District and Colonel Kenneth R. Nichols, district engineer, approximately a hundred companies, universities and research organizations were selected for their significant contributions to the research, development and engineering phases of the atomic bomb project. All are prime contractors of the Manhattan District, with whom they are to share the Seventh Award for Chemical Engineering Achievement which will be presented in New York City on February 26, 1946.

Respectfully submitted,
S. D. KIRKPATRICK, Secretary
Committee of Award.

Participating Companies and Universities

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Aluminum Co. of America, Pittsburgh, Pa.
American Cyanamid Co., New York, N. Y.
Bakelite Corp., New York, N. Y.
E. B. Badger & Sons Co., Boston, Mass.
Bart Manufacturing Co., Belleville, N. J.
Baker & Co. Inc., Newark, N. J.
Beach-Russ Co., New York, N. Y.
Bell Telephone Laboratories, Inc., New York, N. Y.
Brush Beryllium Co. and Brush Laboratories, Cleveland, Ohio
Bryant Electric Co., High Point, N. C.
Calumet & Hecla Consolidated Copper Co., Calumet, Mich.
Carbide & Carbon Chemicals Corp., New York, N. Y.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Chrysler Corp., Detroit, Mich.
Combustion Engineering Co., Inc., New York, N. Y.
E. K. Comstock & Co., Inc., New York, N. Y.
Cook Electric Co., Chicago, Ill.
Crane Co., Chicago, Ill.
Distillation Products, Inc., Rochester, N. Y.
E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
Electro Metallurgical Co., New York, N. Y.
Famsteel Metallurgical Corp., N. Chicago, Ill.
Fercleve Corp. and The H. K. Ferguson Co., Inc., Cleveland, Ohio
Fisher Governor Co., Marshalltown, Iowa
The Fluor Corp., Ltd., Los Angeles, Calif.
Ford, Bacon & Davis, Inc., New York, N. Y.
Foster Wheeler Corp., New York, N. Y.
Geo. A. Fuller Co., New York, N. Y.
Fulton Syphon Co., Knoxville, Tenn.
General American Transportation Corp., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
The Girdler Corp., Louisville, Ky.
Grayson Heat Control, Ltd., Lynwood, Calif.
Grinnell Corp., Providence, R. I.

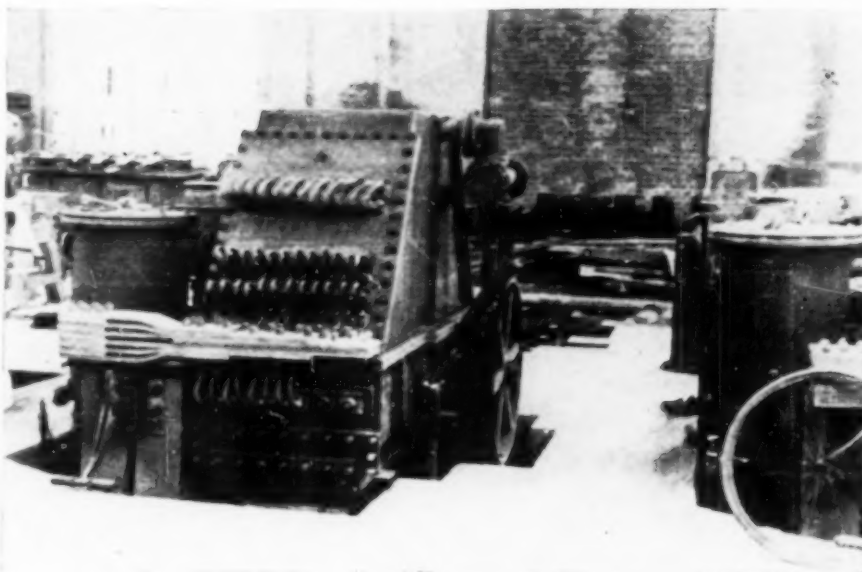
Handy & Harman, Inc., New York, N. Y.
Hanley & Co., Chicago, Ill.
Harshaw Chemical Co., Cleveland, Ohio
Hooker Electrochemical Co., Niagara Falls, N. Y.
Houdaille-Hershey Corp., Detroit, Mich.
International Nickel Co., Inc., New York, N. Y.
Interchemical Corp., New York, N. Y.
The C. O. Jelliff Mfg. Corp., Southport, Conn.
Johnson, Matthey & Co., Inc., New York, N. Y.
J. A. Jones Construction Co., Charlotte, N. C.
Kellogg Corp. and The M. W. Kellogg Co., New York, N. Y.
Kinetic Chemicals, Inc., Wilmington, Del.
W. C. Kruger, Inc., Santa Fe, N. M.
The Linda Air Products Co., New York, N. Y.
Link-Belt Co., Chicago, Ill.
Robert E. McKee, Inc., El Paso, Tex.
McGeon Chemical Co., Cleveland, Ohio
Mallinckrodt Chemical Works, St. Louis, Mo.
Metal Hydrides, Inc., Beverly, Mass.
Metals Disintegrating Co., Elizabeth, N. J.
Midwest Piping & Supply Co., Inc., St. Louis, Mo.
Monsanto Chemical Co., St. Louis, Mo.
National Carbon Co. Inc., New York, N. Y.
National Research Corp., Boston, Mass.
Norton Co., Worcester, Mass.
Pacific Pump Works, Huntington Park, Calif.
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.
Phelps-Dodge Co., New York, N. Y.
Poe Piping & Heating Co., Greenville, S. C.
William A. Pope Co., Chicago, Ill.
Process Engineering, Inc., Somerville, Mass.
Ravara Copper & Brass, Inc., New York, N. Y.
Roano-Anderson Co. and Turner Construction Co., New York, N. Y.
Sargent & Lundy, Chicago, Ill.
A. S. Schulman Electrical Co., Chicago, Ill.
Singmaster & Breyer, New York, N. Y.
The Sharples Corp., Philadelphia, Pa.
Skidmore, Owings & Merrill, Chicago, Ill.

Standard Oil Co. (N. J.), New York, N. Y.
Standard Oil Co. of Indiana, Chicago, Ill.
Stone & Webster Engineering Corp., New York, N. Y.
M. M. Sundt Construction Co., Tucson, Ariz.
Taylor Instrument Companies, Rochester, N. Y.
Tennessee Eastman Corp., Kingsport, Tenn.
U. S. Metals Refining Co., New York, N. Y.
United States Vanadium Corp., New York, N. Y.
Valley Iron Works Co., Appleton, Wis.
Vanadium Corp. of America, New York, N. Y.
Vascoloy-Ramat Corp., N. Chicago, Ill.
Victoreen Instrument Co., Cleveland, Ohio
The Vitro Mfg. Co., Pittsburgh, Pa.
Watson-Flagg Engineering Co., New York, N. Y.
Western Electric Co., New York, N. Y.
Westinghouse Electric Corp., Pittsburgh, Pa.
Whitehead Metal Products Co., Inc., New York, N. Y.
York Corp., York, Pa.

UNIVERSITIES AND RESEARCH ORGANIZATIONS
Battelle Memorial Institute, Columbus, Ohio
Brown University, Providence, R. I.
California Institute of Technology, Pasadena, Calif.
University of California, Berkeley, Calif.
University of Chicago, Chicago, Ill.
Columbia University, New York, N. Y.
Cornell University, Ithaca, N. Y.
University of Illinois, Urbana, Ill.
Iowa State College, Ames, Iowa
The Johns-Hopkins University, Baltimore, Md.
Massachusetts Institute of Technology, Cambridge, Mass.
University of Michigan, Ann Arbor, Mich.
University of Notre Dame, South Bend, Ind.
Ohio State University, Columbus, Ohio
Princeton University, Princeton, N. J.
Purdue University, West Lafayette, Ind.
University of Rochester, Rochester, N. Y.
Washington University, St. Louis, Mo.
University of Wisconsin, Madison, Wis.
Yale University, New Haven, Conn.

Germanys' Vertical Rotating Cathode MERCURY CELL

The German caustic-chlorine industry has turned out to be one of the most fruitful for U. S. investigators, and no feature of the industry has provoked more curiosity than the rotating cathode mercury cell. This vertical cell occupies only a fraction of the floor space required for conventional horizontal types. Experience has been too limited to permit positive evaluation of economic factors, but the cell's mechanical feasibility is attested by the fact that it figured prominently in German plant expansions.—Editors



Latest version of the novel vertical chlorine cell developed by I. G. Farben at Ludwigshafen. At rated capacity, 24,000 amp., its chlorine output per sq. ft. is triple that of the modern horizontal cells shown on next page

LAST October *Chem. & Met.* published an article by Ralph M. Hunter which described conventional German caustic-chlorine cells, both the mercury and the diaphragm types. Since that time information has been released concerning a very unconventional vertical type developed by I. G. Farben and found by U. S. observers in four of their plants, at Ludwigshafen, Rheinfelden, Huls, and Heydebreck. The particular advantage of the vertical cell is its large capacity per unit of floor space.

Cell design was still in the process of evolution when the war ended and differed from one plant to another, depending upon the stage of development at which the particular installation was made. The most recent version, and probably the best, is represented in the cells which were being put up at Ludwigshafen when the plant was forced to shut down in August 1944.

The cell as it was found there (see

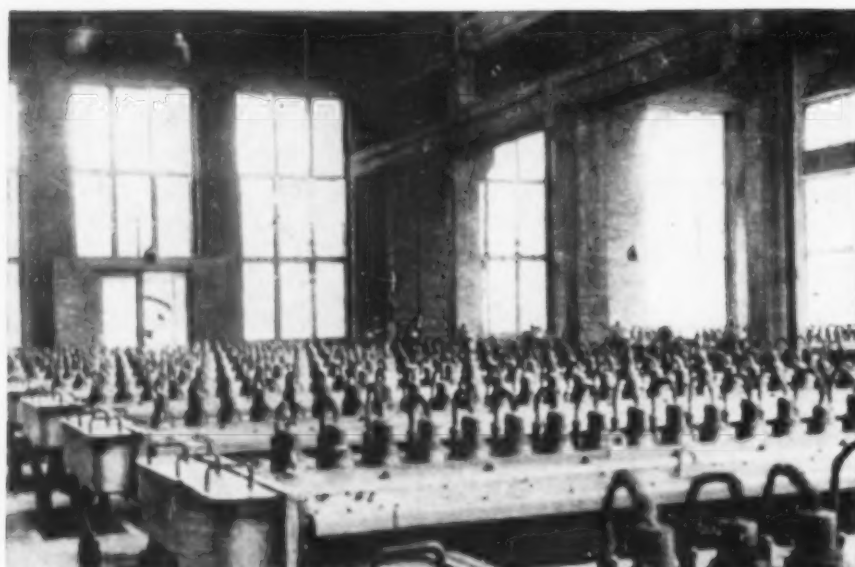
sketch, which was drawn from the description to follow) consists of a steel drum, or rotor, 0.60 m. in diameter by about 0.50 m. in width mounted on a horizontal shaft. This drum carries five circular cathode plates at right angles to its axis, each plate being 1.85 m. in diameter, about 2 cm. thick, and spaced equidistant from each other. The drum and its plates are enclosed in a steel housing which is split horizontally into three sections. These are flanged and bolted together. The top section has sloping sides; the middle section is roughly square sided; and the bottom section is curved to conform to the circular cathode plates. The middle section extends from about 16 cm. above the center of the rotor shaft to about 20 cm. below it. All but the bottom section are rubber lined. The cathode assembly is rotated at about 7 rpm. by means of a 0.55-kw. motor and V-belt drive. Six sets of graphite anodes are supported from the cell housing through connectors; one shortcoming of the cell is the fact that these anodes are stationary and not adjustable laterally to compensate for wear. Anode assemblies are split horizontally and a 20 mm. space left to facilitate circulation of the brine.

Approximately 1,300 kg. of mercury fills the bottom of the cell housing to a height about 2 cm. above the bottom of the rotor. Built-in partitions nearly fill the spaces between the lower portions of the cathode plates and cut down considerably on the total volume of mercury.

Purified and nearly saturated hot brine (70 deg. C., 310 gpl.) is fed in through the cell housing at one end just above the surface of the mercury. This brine fills the entire housing above the mercury to within about 4 cm. of the top where it overflows, after depletion of its NaCl content to about 260 gpl. Chlorine gas also passes out through this overflow pipe and is later readily separated from the weak brine.

A vertical direct connected centrifugal pump (0.8-kw. motor) is located just outside the cell. The HgNa amalgam, containing 0.15 percent sodium, flows into it and is pumped at a rate of 200 kg. per min. to the top of a vertical cylindrical tank, or decomposing "tower," which is about 0.5 m. diameter and 1.0 m. high. It is filled to within 15 cm. of the top with pieces of graphite (roughly 5-mm. cubes). The amalgam enters the bottom of the tower through a pipe which rises to a point about

Material for this article is taken from the reports of two U. S. investigation teams who in turn got their information by observation and interrogation of German plant personnel. At the end of December 1945 these two reports, one by J. G. Kern, R. L. Murray, and R. W. Sudhoff for Chemical Warfare Service, and the other by Joseph Neubauer and Z. G. Deutsch for TICC, had not yet been reproduced for general distribution by the Office of the Publication Board, Department of Commerce.



Customary German mercury cell is horizontal trough type, like these 16,000-amp. cells in I. G. plant at Höchst. To help U. S. catch up in Hg cell development, both vertical and horizontal types will be brought here for experiment

10 cm. below the top, where it ends in a special return bend fitting which causes the amalgam to flow vertically downward into the graphite packing. Distilled water flows into the tower through the side, just above the bottom, and passes upward through the tower countercurrent to the down flowing amalgam, finally overflowing through the side at a point just above the graphite packing. The flow of water is so regulated that the caustic solution is at the desired concentration, which was stated to be controllable between 50 and 70 percent. The hydrogen which is also formed in the $\text{Na-H}_2\text{O}$ reaction passes out through the same overflow pipe to be separated later from the caustic solution. Mercury, its sodium content reduced practically to nil, flows by gravity out of the bottom of the tower and back to the opposite end of the cell.

Current flows to the graphite anodes from bus bars on each side of the cell through 96 leads, 48 on each side. Of these, 72 pass through the top section of the housing and are not insulated from it, whereas the 24 which pass through the middle section are insulated from the section walls. The top section is therefore anodic and the middle and bottom sections cathodic. The middle section is insulated from the top by carrying the rubber lining around the junction flanges and by insulating the bolts which hold the two sections together. Bus bars connected to each end of the cathodic bottom section lead current away to the anodes of the next cell in line. Each cell has two "jumper" switches attached to the anode bus at each end of the cell so that current can be by-passed and the cell cut out for repair.

In operation the five rotating steel cathodes become amalgamated as they pass

through the mercury in the bottom of the cell. It was stated that this mercury coating spreads thinly over the entire surface and will persist for 24 hr. even when no current is passing through the cell. When current is on and the cathodes rotating, the mercury coating picks up the sodium formed by electrolysis of the brine. Then,

as the cathode moves out of the brine zone and into the mercury, the amalgam dissolves in the mercury bath and is replaced by mercury of lower sodium content from the bottom of the cell.

At the time all operation had to be suspended, Ludwigshafen had nearly completed a 20,000-ton per year enlargement of its chlorine plant. This enlargement included an extension of the cell room in which 84 of these vertical cells were being installed. Of this number 28 were in place and nearly ready to operate. Though rated capacity for the cell is 24,000 amp., one was operated experimentally for several months at 40,000 amp. At rated capacity it requires only about 19 sq. m. of floor space, including aisles, per 1,000 kg. of Cl_2 per day. This compares with 60 sq. m. for 16,000-amp. horizontal mercury cells and still more space for horizontal cells of lower amperage.

Even the 28,000 amp. cells which were developed by I.G. at Höchst, which are 14 m. long and said to be the largest of their type in the world, required something over 50 sq. m. per 1,000 kg. of chlorine per day.

This type cell has not been operated for a long enough period of time to establish thoroughly such factors as over-all power consumption, voltage, graphite life, and durability of parts, particularly the rubber lining. However, it must have shown real promise or it would not have been used as the basis for a major plant expansion. It

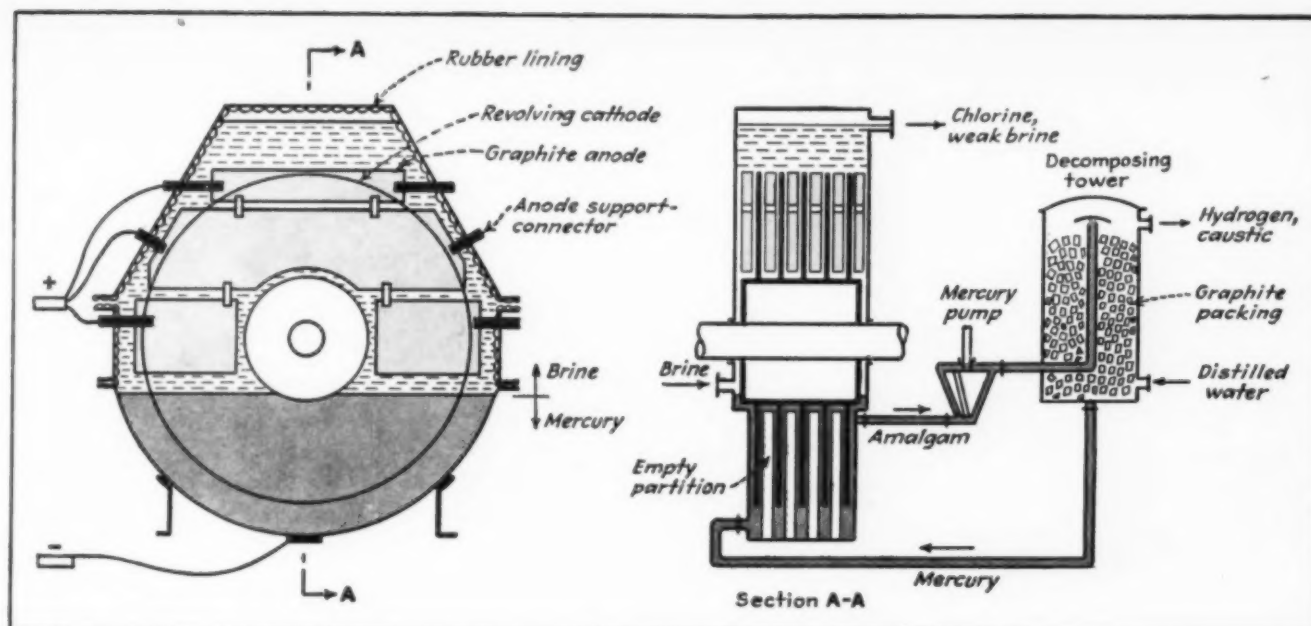
Estimated German Chlorine Capacity

(In Metric Tons per Year)

Works	Owner	Produced in 1942		Projected for 1944	
		Hg Cells	Dia. Cells	Hg Cells	Dia. Cells
Auschwitz	I. G. Farben			30,000	
Bitterfeld	I. G. Farben	34,000	34,000	35,500	35,500
Dyhernfurth	I. G. Farben				
Gendorf	I. G. Farben	26,600		42,700	
Gersthofen	I. G. Farben	22,000		28,700	
Heydebreck	I. G. Farben			17,000	
Höchst	I. G. Farben	20,800		40,800	
Huls	I. G. Farben	20,000		32,000	
Knapsack	I. G. Farben		12,000		12,000
Ludwigshafen	I. G. Farben			11,000	
Leverkusen	I. G. Farben	36,800		44,000	
Ludwigshafen	I. G. Farben	33,500		63,000	
Moselhof	I. G. Farben			27,000	
Rheinfelder	I. G. Farben		24,800	6,000	29,000
Schkopau	I. G. Farben	36,300		48,000	
Urdingen	I. G. Farben			16,000	
Wolfen	I. G. Farben		13,000		13,000
Amendorf	Gold Schmidt, A. G.		14,000	6,000	14,000
Aumig	Chem. Werke, Aumig	16,000		22,300	
Brück	Donau Chemie, A. G.		3,000	3,800	3,000
Burghausen	Wacker München	5,500	9,000	5,500	9,000
Gretzlein	Lebkam-Josefstal, A. G.				
Hallein	Wien		850		850
Haynan	Solvay	300	4,000	300	4,500
Kelheim	Pepierf Haynan		350		350
Loladorf	Zellstoff Walhof		1,850		1,850
Möckenberg	Feldmühle, A. G. Stettin		12,700		15,200
Niederau	Wacker München	5,500		11,500	
Odermünde	Rütger Berlin		6,400		6,400
Osternienburg	Feldmühle, A. G. Stettin		1,500		1,500
Pirna	Solvay	11,500		17,500	
Tahm	Aschaffenburg				
Weinig	Zellstoff, A. G.	3,000		3,000	
Westeregeln	Kalichemie		6,000		6,000
Zscherndorf	Chem. Fabrick				
	V. Heyden		7,000		10,500
	Cons. alkaliwerke				
	Westeregeln		14,500		14,500
	Kalichemie, Berlin		22,200		28,200
Total		271,860	187,150	501,660*	199,350*

Table was prepared for Messrs. Neubauer and Deutsch by I.G.'s superintendent of chlorine electrolysis at Ludwigshafen and is alleged to include all of Germany's chlorine capacity except for very small plants. After several partial checks Neubauer and Deutsch found the data to be reasonably correct with two exceptions. The Knapsack plant has metallic sodium-chlorine cells rather than diaphragm cells and is owned by Degussa, although I.G. markets the chlorine. Secondly, it was said that additional 18,000-amp. mercury cells were installed as follows: 75 in 1942 and 75 more in 1944 at Niederau, and 150 in 1944 at a plant in Javornno in Schlesingen.

* This projected rate of production was never reached because of war damage.



Vertical chlorine cell, Ludwigshafen design. Sodium is carried out of brine electrolysis zone by mercury-coated cathodes; amalgam dissolves in mercury bath and goes to decomposer for removal of sodium with water. Cycle is continuous

was expected that the voltage of the cell would be 3.75 at the start and 4.7 at the finish of an anode run, though this may be too optimistic. Whether the lower anode current density (1,700 amp. per sq. m. as against 2,500 to 3,500 for the horizontal cells) will counterbalance the fact that the anodes are not adjustable to compensate for wear, is yet to be determined. Ampere efficiency was stated to be 92-93 percent, which is rather low.

Next to Ludwigshafen, the most recently designed cells are those at Rheinfelden, where 20 vertical cells had been in operation for a few months. The over-all construction of these cells was very similar to the newer ones at Ludwigshafen, but it was apparent that a few refinements had been made. The cathode disks are about the same diameter, but there are only four of them; they are somewhat farther apart; and they are attached directly to the small drive shaft with no large hub, or drum. By bringing the cathodes closer together and adding a fifth one, the later design at Ludwigshafen obtained greater cathode area; and by adding the large rotor the cathode plates are stiffened, mercury inventory is cut, and the shaft stuffing box is placed above the mercury level. Another modification is seen in the fact that the upper section of the cell housing at Rheinfelden is straight sided; the subsequent adoption of sloping sides reduced the length of anode supports, thereby requiring less copper in the connectors and lending greater strength and rigidity to the anode assembly. According to the operators at Rheinfelden, their chief sources of trouble were partial short circuiting at the anode leads due to leaking of the anolyte, warping

and magnetic distortion of the anode disks, and the still unsolved problem of feeding anodes toward cathodes.

Much older than the design at either Rheinfelden or Ludwigshafen is the version found at Hüls. That is the only large installation and the only plant with several years consistent operating experience. There are four rows of 30 cells, all alike and normally carrying 24,000 amp., which corresponds to 9.75 lb. of chlorine per sq. ft. of two-story building per day. The entire 120 cells have been operated as high as 30,000 amperes.

Operations began in October 1940 and one bank was being started in August 1945 after the recent war shutdown. The cells were said to have run very well for the first month, but soon thereafter the amalgam decomposers failed to operate and it was found that tin and copper had contaminated the mercury. This was helped by ferric chloride treatment of the carbon in the decomposing cells but the trouble was still serious. The cause of contamination was found to be the copper leads to the anodes. These had been rubber-coated copper. By a step-wise evolution they were changed to carbon rods screwed into the anode blocks only as far as these extended beyond the cathode disks. The rods are

rubber-ring packed through the steel cell sides and copper leads are tinned into them by centrally bored holes. Another difficulty was friction of the disks against the displacers in the bottom half of the cell; it was also found the hydrogen was diffusing into the steel inclosures of the displacers. Both troubles were overcome by making new displacers entirely covered with heavy rubber.

Losses are between 0.5 and 1.25 lb. of mercury per ton of chlorine, and carbon consumption is given as between 0.45 and 0.65 kg. per 100 kg. of chlorine with some hope of a small reduction if the mechanical problem of anode adjustment can be worked out. Power consumption is stated to be 360 to 400 kwh. of direct current per 100 kg. of NaOH.

Percentage composition of the anode gas is given as: 97 Cl₂, 1.0 CO₂, 1.6 H₂, 0.4 CO, O₂, and N₂.

After filtration through porous carbon candles, the caustic solution analyses, in percent: NaOH 50, NaCl 0.004, Na₂CO₃ 0.33, Na₂SO₄ 0.03, Fe₂O₃ 0.0016, Al₂O₃ 0.20, NaClO₂ 0.00.

In spite of the fact that Hüls offers the only long-time record of the vertical cell's performance in commercial operation, it does not offer a fair basis for appraisal of the cell as a type. Later designs are much improved and demand further attention.

In this connection, it is of interest that a program to exploit the German mercury cell was recently put in motion by Chemical Warfare Service in cooperation with American chemical industry. It includes the re-examination, first in Germany and later in this country, of both the vertical cell and the 28,000-amp. horizontal cell.

Conversion Factors

If Given:	Multiply By:	To Get:
Kilograms.....	2.2	Pounds
Metric tons.....	1.1	2,000-lb. tons
Metric tons/yr.....	6.0	Lb./day
Centimeters.....	0.39	Inches
Meters.....	3.3	Feet
Sq. meters.....	11	Sq. ft.
Kilowatts.....	1.3	Hp.
Liters.....	0.26	Gal.
Reich Marks.....	0.4	Dollars
Amperes.....	0.0118	Metric tons Cl ₂ /yr. @ 100% eff

Modernization Pays Dividends in VARNISH INDUSTRY

One of the ancient process industries, varnish making, has grown in the past few years from an art to a science. Realizing the importance of this trend, *Chem. & Met.*, in November 1944 published a report summarizing the growth and advance of the paint and varnish industry and showing where gains had been made in applying up to date chemical engineering practice to this hitherto backward field. An example of this progress in the varnish industry is herein given.—Editors

MODERN RESEARCH together with modern chemical engineering methods and equipment have made steady progress during the past three decades in providing the paint and varnish industry with increasingly better and more satisfactory raw materials. Only in recent years, however, have traditional methods of varnish making given way to the engineering progress which has so characterized the chemical process industries. Among the leaders in this field is the Vita-Var Corp., Newark, N. J., which in 1937 began a program of modernization resulting in the installation of a new system for preparing varnish and the varnish-like vehicles used in manufacturing paints, enamels, and other coatings. By taking advantage of up-to-date equipment, this company has achieved notable success in obtaining higher and more uniform product quality, greater production, better control, savings in labor, savings in space, increased safety and fire protection, together with improved efficiency and greater plant cleanliness.

Key operation of the varnish making process is cooking, in which resins and drying oils are heated together causing further polymerization of oils and inter-esterification of the oils and resins. Permanent dispersion or miscibility of these materials is attained

and viscosity is increased. Traditional methods of operation consist of heating the components in open portable kettles of 200 to 300 gal. capacity mounted on low trucks which are wheeled over open fire pits. The batch is stirred manually and temperatures are observed on a stem thermometer which is immersed in the hot material. When cooking is complete the kettles are pulled from fire and may be allowed to cool naturally, or by water directed on the outside of the kettle. Generally, methods are crude and uniform quality from batch to batch is well nigh impossible.

LARGE KETTLES

Although Vita-Var still uses a few of the old style kettles for small batches of special material, by far the bulk of its output is now processed in modern equipment. The heart of the new installation consists of three set kettles having a combined capacity of 4,800 gal., equivalent to 24 portable kettles. Made of stainless steel they are completely closed, except for a charging port or manhole where weighed charges of resins are loaded in prior to or during heating, and through which cooking progress is observed and test samples taken. Drying oils are metered into the vessels through a swiveled pipe connection from the oil storage tanks, fumes are removed by suction fans through a duct at the top of the kettle, and the cooked material is discharged by means of a rotary gear pump which draws the varnish through cooling coils to the thinning tanks. An adjustable, motor-driven, vertical agitator prevents localized overheating, causes thorough mixing of the components, and insures uniform cooking.

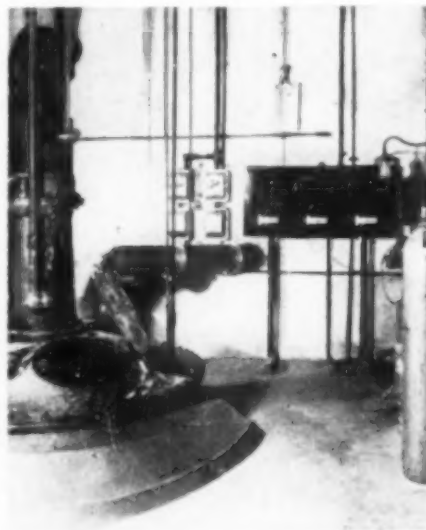
Installed so that the charging port is about 12-in. above the floor level the reaction vessels, which are over 7 ft. in diameter, extend below the floor into the basement. Each kettle is supported by a masonry structure which also serves as insulation and provides a closed furnace for heating the kettle. A pilot-operated oil burner which may be adjusted from the operating floor, supplies heat.

Each kettle is equipped with an external heat exchanger for cooling the varnish after cooking, since the temperature must be

lowered considerably below the flash point of the volatile solvents or thinners which are added after cooking. The cooling equipment is piped up so that the cooled varnish may be recirculated back to the kettles when necessary. Since the reactions in the cooking kettles are exothermic, overheating of the batch sometimes occurs even after the fire under the kettle is cut off; when this happens prior to the end of the cooking it may be necessary to circulate the material through the cooling equipment and back to the kettle for further cooking. In this manner, overheating of the varnish with consequent deterioration of the quality is held to a minimum and the desired cooking temperature can be maintained very closely.

Obnoxious odors and atmospheric pollution by the fumes and gases given off during the heating cycle are minimized by passing the exhaust gases through a water-cooled condenser which removes most of the gases and vapors. The actual loss of valuable material in the exhaust is too small to attempt recovery, so the liquid from the exhaust condenser is discarded to the sewer.

Individual controllers prevent overheating in the varnish kettles; note flame detection element located vertically above the charging port



Careful cooking schedules are followed during the process and while actual control is manual, this manual control is guided and protected by instruments. A strip chart multiple-record pyrometer provides a permanent record of every batch in each kettle and guides the operator in adjusting the fuel valve on the oil burner. This chart record makes it possible to exactly duplicate any cooking schedule, and permits a check on individual operations.

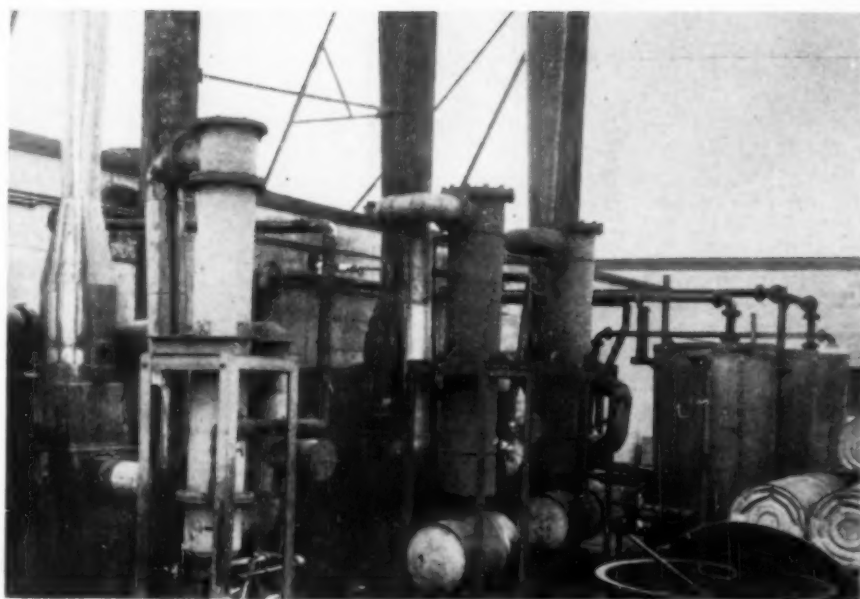
Possibility of overheating is minimized by use of individual indicating pyrometer controllers on each kettle, which in effect provide a high temperature limit control. The maximum temperature is set on the instrument prior to the heating cycle and when this temperature is reached the oil burner is shut off automatically. When this occurs the burner must be started manually if further heating is necessary.

One of the highlights of the entire installation is the simple but effective fire protection system necessary when processing such flammable materials which may be heated to temperatures approaching their flash point. Consisting of a flame detection device and an instrument which operates a control valve in a line from the battery of CO_2 cylinders, each of the three installations is individually protected. The flame detector is located vertically above the charging port, which is kept open during cooking, high enough so that it doesn't interfere with the loading operation, and is focused on the surface of the material in the kettle. Should fire start, the flame is detected instantly; the controller opens the control valve and the surface of the varnish is immediately blanketed with CO_2 to smother the flame.

It has been found from experience that fires starting in the kettles spread quickly through the fume ducts into the condenser and even into the stack. Therefore, it is possible for a fire to be extinguished in the kettles without affecting a fire that might possibly exist in the rest of the system, which subsequently might find its way back to the kettle. For this reason, CO_2 is injected into the duct and also into the fume condenser to give maximum fire protection. Since this system has been in use no serious fires have occurred to mar the production record.

STAINLESS USED

Stainless steel is used throughout the kettle installation to prevent corrosion by fatty acids and other corrosive substances formed when the varnish materials are heated. While comparatively little is known of the complex reactions which occur in the varnish cooking process, it is well established that the quality and especially the color of the final product is improved by the use of stainless steel equipment. This includes the kettle, thermocouple wells, heat exchanger, and the various valves, pipe fittings, etc. The system is so hooked up that by manipulation of valves it can be thoroughly flushed



Exhaust gases pass through condensers before discharging into the atmosphere; heat exchangers for cooling the cooked varnish are shown at the right

clean by pumping solvent or thinner through the pipes, heat exchangers, pump, etc. The kettle itself must be cleaned periodically since it is neither practical nor safe to flush it with a volatile solvent after each cook.

PROCESS DESCRIPTION

Although the cooking kettles are used for various purposes, including "bodying" of oils, and "running" of natural resins, the principal purpose is to heat the proper mixture of resins and drying oils together to form varnish. Raw materials include various natural and synthetic resins and, especially during the war, many types of drying oils. The resins are received in drums, and most of the oils are received in bulk and stored in underground tanks. Separate tanks above the ground are used to store bodied oils since they are too heavy to pump satisfactorily for any appreciable vertical distance.

Various products are made from a wide variety of raw materials. Formulas for the products are carefully followed and include many variations, depending on the product being made and the particular resins or oils used. The resins are weighed carefully on a platform scale and loaded into the top of the kettle while the required amount of oil is metered from the storage tank to the kettle. These may or may not be added prior to cooking; often, the oils are added after the resins are heated. All sorts of variations occur in cooking schedules, depending on the particular type of product being made. Perhaps the more normal cooking schedule in the production of resin varnishes consists of about three hours' "coming up" time to bring the temperature up to 575 deg. F.; this temperature is held for three to four hours and then cooled before going to the thinning process.

While the cooking cycle is followed according to a prearranged schedule, it is necessary to test each batch to determine whether it has been cooked sufficiently or not. One reason for this is that the raw materials are not always uniform in quality, and also that different types of resins and oils may be used to obtain the same type of final product. Samples are withdrawn from the kettle and are thinned down according to the particular formulation desired, after which they are tested for viscosity by the bubble method. This is a spot test, but is sufficiently accurate at this stage of the process and is far more satisfactory than previous methods. When the cooking is completed the cooked varnish is pumped through the heat exchanger where it is cooled to about 300 deg. F., and then passes to the thinning tanks.

Each of these agitated vessels is large enough to hold a full batch from one cooking kettle, even after thinning to the desired formulation. Here the correct amount of volatile solvent is metered into the tank and is thoroughly mixed with the cooked varnish after which samples are taken to the laboratory where complete tests are run on color, body, drying time, viscosity, acid number, refraction, and total solids. At this point it is possible to adjust the final quality by addition of small amounts of necessary ingredients. When the tests are completed and found satisfactory, the material is passed through a plate and frame filter press together with a filter aid for removing any insoluble material that may be present; in some cases, however, it may be run through a centrifuge for this same purpose. The material is then metered to final storage tanks, after which it may be used as a raw material or vehicle for paints, enamels and other coatings, or it may be packaged directly in the form of varnish.

MIXING LIQUIDS

In Shallow Tanks Aided by Design Analysis

A problem often arising in the operation and design of mixing equipment is how to assure adequate agitation during periods of low liquid level. The difficulties attending such operation can be minimized by taking into consideration some of the basic elements involved. In this article, the authors have analyzed various cases and have come up with some simple but effective rules which, if followed, should help eliminate many of the troubles encountered in this work.—Editors

ALTHOUGH agitation with propellers and turbines is usually accomplished most successfully in cylindrical tanks of diameter equal to the depth of liquid, it occasionally becomes necessary to agitate liquids in more shallow vessels. Frequently too, it is necessary to continue operation while the tank is being drained, and it is common occurrence for the agitator to remain in operation until the liquid level actually falls below the impeller. In this case, such as when an impeller breaks through a liquid level, severe strains develop in the impeller drive shaft, and the mechanical design of mixer installation must be able to care for this condition adequately. Aside from the mechanical strength requirements, the problem of assuring adequate agitation at low and falling liquid levels is not a simple one. For those encountering these types of operations, an analysis of the pertinent factors should be helpful in selecting the most suitable conditions.

Agitators are commonly used to suspend solids, disperse immiscible liquids, blend liquids, disperse gas, improve heat exchange and to control crystal size, and the problem of agitation in low-level liquids will be encountered in all these applications. In

any such mixing operations, however, there are certain factors that cannot be changed because of physical reasons. The first of these is the depth of liquid required over an impeller to prevent vortexing. This necessary depth has been found to be $1\frac{1}{2}$ times the propeller diameter, whether the propeller enters from the top or through the side of the container, or whether a turbine, propeller, or paddle arm is being considered. Therefore, the larger the impeller, the higher the liquid level will have to be in order to prevent vortexing. Vortexing is undesirable because it may allow the introduction of air or gas into the liquid, and so severely reduces the vertical currents of agitation that any heavy particles present drop out of suspension.

The second fixed factor is the depth of liquid, in proportion to the diameter of the tank, required for satisfactory agitation. Certain maximum ratios of tank diameter to minimum liquid depth have been found by experience. These ratios for various minimum liquid depths are given in the table.

For example, if the lowest liquid depth is 10 in., the diameter of the vessel should not exceed 20 in. On the other hand, if the lowest liquid level is 20 ft., the tank may be up to 140 feet in diameter (such sizes are reached in gasoline blending). In applying these ratios, however, the first factor mentioned, namely the minimum depth of liquid above the impeller to prevent vortexing, should not be forgotten.

With these two points in mind we may consider situations where low-level liquids are apt to be encountered. The first and most common condition is where a shallow tank, not primarily designed for agitation, is to be used. Usually this occurs merely because one happens to be available. In many cases the proportions of these shallow

tanks are such that they should be discarded as potential mixing vessels.

Another situation requiring agitation in low levels arises where small batches must be made in deep tanks. This occurs where it is necessary to make batches of different size in a single tank with a single mixing device. It also occurs where different products of varying batch size are to be made in the same tank. It may also occur in the preparation of emulsions, where a small "starter" batch must be prepared before the emulsion can be extended by addition of quantities of the continuous phase.

CAREFUL DESIGN NECESSARY

These several situations may often be met by careful choice of tank and impeller proportions. Where extreme flexibility is desired, a combination of one large and one small tank is best as shown in (a) and (b).

Difficult problems arise in maintaining a suspension such as a filter aid, while it is slowly being drawn off. If at all possible, a constant remainder or "heel," should be used to provide the minimum depth for proper agitation see (c). The placing of a small well in the bottom of the tank as in (d) offers a good solution. It is also a practical method of starting small batches where emulsions are to be prepared. In addition, the following must be taken into account: (1) Proportions of the tank, (2) number and size of tanks, (3) shape of tank bottom and corners, (4) rate of liquid draw-off, (5) type of impeller, (6) size of impeller, (7) number of impellers, and (8) variable speed of impellers.

In discussing these variables, consider first those having to do with the tank itself. Obviously, a tall tank of small diameter holding the same volume as a large diameter tank will give greater liquid depth as illustrated in (e). No tank should be considered for suspension of solids, where the slurry is to be drawn off, unless the depth is at least equal to the diameter of the tank and preferably $1\frac{1}{2}$ to 2 times the diameter. Starting with a properly proportioned tank, the next important factor is the shape of the tank bottom. If a tank bottom is perfectly flat with sharp

Maximum Ratios of Tank Diameter to Minimum Liquid Depth

Minimum Liquid Depth	Maximum Ratio of Tank Diameter to Minimum Liquid Depth
Up to 1 ft.	2
1 to 5 ft.	3
5 to 10 ft.	4
10 to 15 ft.	5
15 to 20 ft.	7

* Professor of Chemical Engineering, University of Virginia, Charlottesville, Va.

corners (f), the centrifugal action of any agitator in the tank will tend to throw the solids out to the sides of the vessel, especially as the batch becomes lower and lower. If the vessel is drained from the center, solids will accumulate in the corners of the tank. But if the tank is drained from the side, the slurry will grow less dense during draw-off. These difficulties may be overcome by the use of a dished bottom, and the deeper the dish the better will be the result. A cone bottom tank as in (g), is still better, since a cone holds only one third of the volume of a cylinder of equal height and diameter. Where horizontal cylindrical tanks must be used, one end can be raised, thus increasing the liquid depth at the opposite end where the impeller would be placed.

The lower propeller in a well bottom (d) or cone bottom (g) tank should be sized to the minimum batch volume for which it is intended if a vortex is to be avoided. The relative diameters of propeller and tank will vary with the degree of agitation required and speed of rotation. Generally, the propeller diameter is from $\frac{1}{3}$ to $\frac{1}{2}$ the tank diameter or the diameter of the cone at the position of the propeller (Bissel, Miller, & Everett., *Ind. Eng. Chem.* 37, 426, 1945).

IMPORTANT FACTORS

The rate of liquid draw-off is also important. In preparing a slurry of filter aid to be run through a continuous filter at a fixed rate, it may be desirable to use a large tank sized to hold the entire volume for a single shift or day. The rate at which the liquid level will fall is dependent upon the diameter of the tank and the rate of draw-off. Assuming that the demand is fixed, it is better to use two or three tanks instead of one large tank. Then the rate of fall may be rapid enough so that the material will remain suspended from the time it leaves the lowest impeller until the tank is empty. In other words, the length of time required to empty a tank after the liquid level reaches the lowest impeller should be less than the settling time of the material being handled.

How To Avoid Low Liquid Levels

DON'T mix small volumes in large tanks.
USE a combination of tanks.

USE a schedule of operations so that "heel" or a constant remainder can be maintained.

USE a bottom shape of well or cone type to increase depth for a given volume.

When Low Levels Can't Be Avoided

DON'T USE square, rectangular, or horizontal cylindrical tanks.

DON'T USE tanks with flat or dished-in bottoms.

USE vertical tall form cylindrical tanks.

USE tanks with dished-out or cone bottoms.

USE generous fillets in the corners of wooden tanks with flat bottoms.

PLACE impeller near bottom.

USE radial rather than axial flow impellers.

USE multiple or variable speed drive.

Having arrived at the most suitable tank proportions, proper number of tanks, proper bottom shape, and the rate of liquid level fall, the best type of impeller should then be selected. All agitating devices depending upon a high rate of turbulence at the impeller, and providing a large pumping capacity or circulation of liquid, fail completely to give satisfactory service in suspending solids in low-level liquids unless all factors mentioned above are carefully allowed for. All impellers have rotary motion, and centrifugal effects are created which tend to throw the solids to the side of the tank. If the impeller is placed very close to the bottom of the tank, its efficiency is impaired due to increased fluid flow resistance. Certain compromises can be made by utilizing a set of two or more impellers (f) and (h). The smaller impeller is intended to be operated at a very low level and set very close to the bottom of the tank, with the larger impeller or impellers well placed so as to handle the bulk of the liquid in the largest batch. For radial flow type impellers, one compromise is shown in (i). Here the impeller is very close to the bottom of the tank, and the blade area is designed for pumping only from the top side of the impeller. This is an excellent expedient when the proper tank propor-

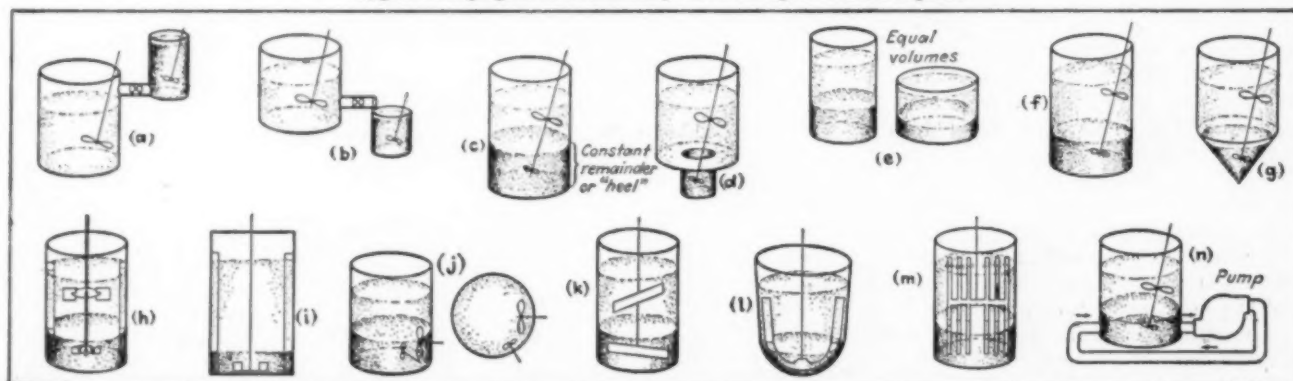
tions are observed and a good shape of tank bottom selected.

In the case of side-entering mixers (j), it is possible to install two units in a single tank, one being large enough for larger batches with the smaller unit sized to handle the smallest batch. Both units may be operated for the large batches and the total amount of installed horsepower designed to meet that condition.

In considering other types of agitators, the conventional paddle type (k) operates satisfactorily in a suitable vessel. This agitator, however, acts as a centrifugal device and tends to accumulate solids at the side wall of the tank if the draw-off time exceeds the settling time. The anchor or horse-shoe type of agitator (l) which operates with close tolerance in relationship to the side wall is often mentioned as being suitable for shallow batches. However, if the basic size and tip velocity of the anchor type impeller is equal to that of a conventional type of radial impeller, the comparable action would be no different except where the blades and tank bottom are so shaped so as to cause downward flow. The conventional anchor impeller will tend to cause stratification of solids rather than suspension. Similarly, the gate or vertical paddle arm agitator (m) is more suitable for thickeners in the settling of solids than for agitation. To resuspend settled solids in shallow batches a pump may be useful as in (n). Draw-off to the pump should be from side outlets and the high velocity discharge used as a jet near the bottom or top.

Finally, a further control of the agitation can be effected by the use of a multiple or variable speed drive. For a given size of impeller a particular speed will provide proper agitation for only a relatively small range of liquid quantity. A single speed may result in insufficient agitation for full tank capacity and conversely will produce too much agitation (possibly causing shredding or excessive breakdown of particles) when the liquid has been drawn off to a low level. This difficulty can be overcome by the use of two or more impellers of the same or different sizes as illustrated in (f) and (h), or by the use of multiple or variable speed drives.

Types of equipment commonly used in agitation of liquids



SOLID CO₂ INDUSTRY

Thrives on Improved Production Methods

For years the development of the solid carbon dioxide industry was retarded by the product's cost and limited supply. However, thanks to more efficient processes, larger capacities per plant, and better methods of distribution, "dry ice" is gaining acceptance in a growing number of applications. It is interesting, as a measure of the technical progress of the industry, that the 360 kwh. once required to produce a ton of solid CO₂ has been reduced everywhere by at least 25 percent and in some plants by as much as 40 percent.—Editors.

TWENTY years ago the solid CO₂ industry was in its pioneering stages; today it turns out over a half billion pounds of product annually. That in brief is the story of the manufacture of "dry ice," and while it is a story of remarkable growth, it is in no sense the story of a war baby. The industry has developed gradually and scientifically and will continue to grow as the specific physical and chemical properties of solid CO₂ are better appreciated and new fields are opened for its use. In the past, one of the greatest mistakes made in the application of solid CO₂ has been to consider it only from the standpoint of its refrigerating capacity, 275 B.t.u. per lb. against 144 for water ice. In many uses its physical characteristics, as compared to those of water ice, are its greatest advantage.

In round numbers, production of solid CO₂ in 1944 was 646 million lb., of which 80 percent went to ice cream refrigeration and 15 percent to meat, fish, poultry, fruits, and vegetables. The remaining 5 percent is spread over a variety of uses, such as chilling aluminum rivets, shrinking cylinder liners

into diesel engines, shipping and cooling serums, and preparing blood plasma, penicillin, and synthetic rubber. On numerous occasions solid CO₂ has been used in placing heavy machinery where an overhead crane could not be employed. A growingly important application is its use in fire extinguishers, either at 1,000 or at 450 psi. At the latter pressure CO₂ is kept liquid by refrigeration and, therefore, upon discharging yields a higher proportion of solid CO₂, a very desirable circumstance from a fire extinguishing point of view.

The increased production of solid CO₂ and the desirability for making shipments up to 1,000 miles or more have compelled producers to develop special cars which will reduce sublimation losses to a minimum. Such cars have a capacity of 30 tons and carry 14 in. of cork, balsa wood and pitch insulation at the bottom and sides. They are provided with built-in conveyors for quick handling and are divided into several compartments to further reduce the loss of CO₂.

Because the transportation of solid, as against liquid, CO₂ is easier and less expensive, the trend in the liquid CO₂ industry is to purchase the solid and reliquefy it in specially designed converters. These are high-pressure cylinders provided with a removable head for charging and capable of holding 1,000 lb. of solid CO₂. After the converter is closed, CO₂ sublimates and of itself builds up sufficient pressure to cause liquefaction.

Containers used for large shipments to consumers are square, corrugated- or flat-steel boxes, welded throughout and insulated

with 6-8-in. cork linings. Some boxes have covers, but the covers are not insulated and therefore a 4-7-in. kapok blanket is placed over the blocks. The containers vary in size, holding from 6 to 20 of the 10 x 10 x 10-in. cakes.

A QUESTION OF ECONOMICS

Carbon dioxide gas can be secured by several methods, but feasibility of its commercial exploitation for the manufacture of solid CO₂ is influenced by its purity, proximity to the potential market, and the cost of power. In some localities the advantage of having a source of very pure CO₂ may be outweighed by one or more unfavorable factors, such as cost of distribution, shrinkage losses, inadequate supply of cooling water, or high power cost.

The actual cost of producing the gas, as well as the amount of it and the impurities it contains, will depend upon the process from which it is taken. For example, the CO₂ given off during the fermentation of molasses or grain for the production of ethyl alcohol has a purity of 99.8-100 percent, while the same raw material fermented for the production of butyl alcohol yields a gas containing 60 percent CO₂ and 40 percent hydrogen. Table I shows the purity of CO₂ obtainable from various raw materials, together with methods of recovery and impurities which must be removed before it can be converted into a marketable product.

The removal of impurities is usually carried out in two steps. Some are removed at low pressure before the gas enters the first stage of the compressor, while the final im-

Table I—Purity of CO₂ From Various Raw Materials

Source of Raw Material	Percent CO ₂ in Gas	Method of CO ₂ Recovery	Impurities	Percent CO ₂ to Compressor
Limestone, dolomite.....	32-41	Absorption in: potassium carbonate sodium carbonate monoethylamine triethanolamine	Dust, SO ₂ , H ₂ S	99.8
Flue gas.....	10-18			
Molasses or grain:				
Ethyl alcohol.....	99.8		Molasses or grain odor	99.8
Butyl alcohol.....	60	Absorp. in water	Hydrogen and molasses or grain odor	99.8
Natural gas.....	96-99.5		Hydrocarbons, SO ₂ , H ₂ S	96-99.5

purities and moisture are removed under high pressure conditions. When fermentation gas is used, it passes first through water scrubbers for the removal of ethyl alcohol and a portion of the odorous substances. After the first stage compression it is completely deodorized and freed of moisture, either by use of activated carbon in combination with chemicals or by chemicals alone (see *Chem. & Met.*, Mar. and May, 1931). If lime kiln, cement, or flue gases are to be processed, then dust and sulphur compounds must be removed in a dust collector and water scrubber containing limestone. Other impurities are removed with oxidizing agents. Finally the CO_2 is dehydrated in a dehumidifier and gas dryer which contains fused calcium chloride, sulphuric acid, alumina, or silica gel.

For the compression, liquefaction and cooling of CO_2 various methods or so-called cycles are used; these are designated according to the principles on which they operate and bear such names as: "bleeder-, precooling-, binary-, ternary-, flash cooling-, etc; cycles." The principles involved in these various cycles may be divided as follows:

1. Operate without booster compressor on the raw gas.
2. Compress the raw gas and part of the revert gas in a three-stage compressor and operate an additional two- or three-stage booster compressor on the revert gas only. Perform all low temperature cooling by flashing off some of the liquefied CO_2 .
3. Compress the raw and revert gas in a two-stage compressor to approximately 450

psi. absolute; liquefy and cool it to a lower temperature by means of ammonia refrigeration.

4. Combine a three-stage CO_2 compressor and ammonia refrigeration.

Though each manufacturer expounds the virtues of a certain principle, the relative economy of each cycle must be judged ultimately on the basis of its adaptability to local conditions, capital investment, and power requirements. In this article a few cycles will be described and shown diagrammatically.

BINARY CYCLE

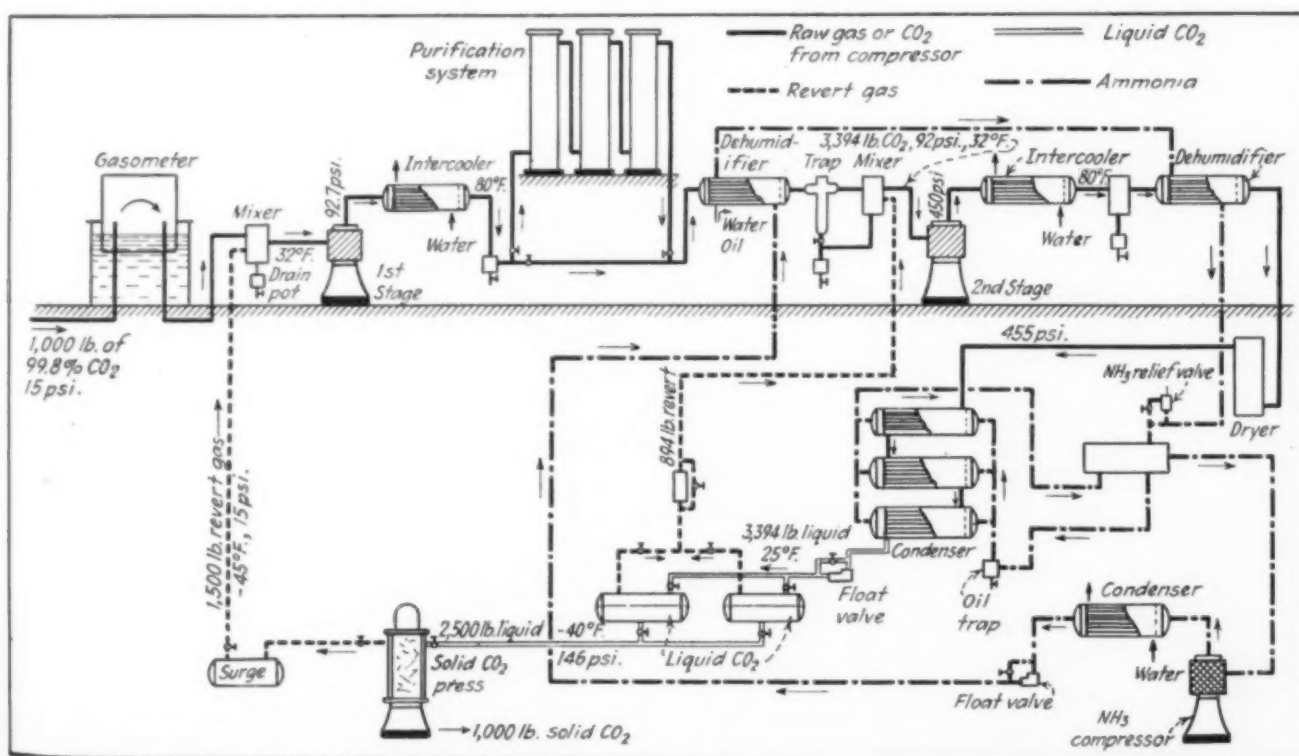
Liquefaction, liquid cooling, and solid CO_2 production by this method (Fig. 1) are accomplished with two two-stage compressors, one for the compression of CO_2 and the other for ammonia refrigeration.

Assuming a plant produces 1,000 lb. of solid CO_2 per hr., then the raw gas from the gasometer saturated with water vapor at the existing temperature and pressure, 15 psi. abs., passes into the low pressure trap where it is mixed with 1,500 lb. of revert CO_2 at -45°F . from the solid CO_2 press. The 1,500 lb. of CO_2 represents in fact the revert gas plus an additional percentage of raw gas which was lost during processing. The gas mixture at 15 psi. abs. and 32°F . enters the suction port of the first stage compressor where the pressure is raised to 92.7 psi. abs. and the temperature in the intercooler reduced to 80°F . The combined 2,500 lb. of CO_2 is

now purified, the method depending upon the source of carbon dioxide. Afterwards the gas passes through the first ammonia cooled dehumidifier and swivel trap, where the condensed water and some oil are removed. The partly dehydrated gas enters the second mixing tank where, with the cold 894 lb. of CO_2 coming from the liquid storage tank, a temperature of 32°F . is obtained. Thus the combined 3,394 lb. of CO_2 enters the suction port of the second stage compressor. The discharge pressure of the second is about 450 psi. abs. and the temperature, after cooling in the intercooler about 80°F . Before the high pressure gas is admitted to the condenser it passes through an oil condenser, not shown on the drawing, for the removal of the entrained vaporized lubricating oil. The gas is cooled in a second ammonia cooled dehumidifier and dehydrated in the dryer. It is important to have a perfectly dry gas, otherwise the valves in the liquid CO_2 line leading to the solid CO_2 press are likely to freeze.

In the ammonia cooled condensers the temperature of the liquid CO_2 is reduced to 25°F . A float valve placed between the liquid CO_2 storage tank and condenser regulates the feed of the liquid discharge, which is partly flashed off into the receiver. By vaporizing approximately 894 lb. of CO_2 , or 26.3 percent, a further reduction to 146 psi. abs. and -40°F . is obtained. The flashed off vapors are returned to the second stage compressor, while the remaining 2,500 lb. of liquid CO_2 is delivered to the solid CO_2 press, where 1,000 lb. of solid CO_2 is

Fig. 1—Binary Cycle uses two two-stage compressors and ammonia refrigeration for liquefaction and cooling of CO_2



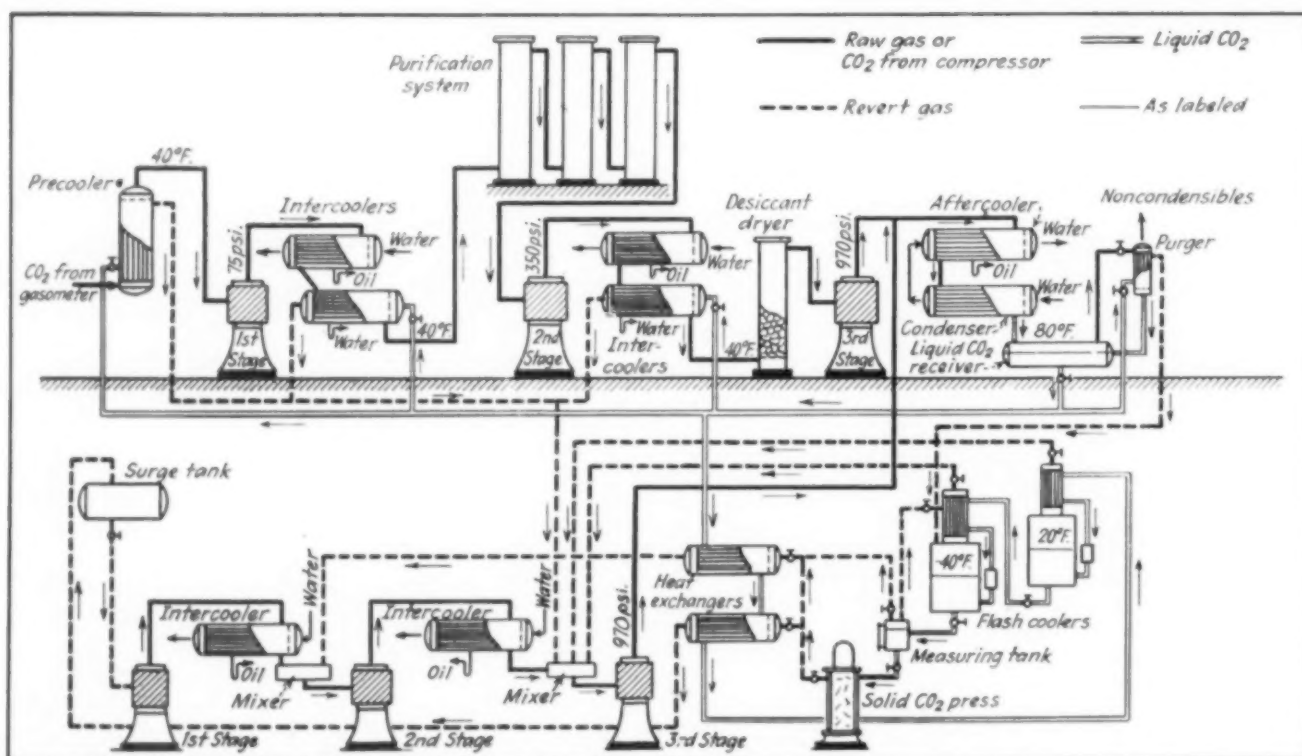


Fig. 2—Ternary cycle liquefies and cools the gas with two three-stage compressors and without ammonia refrigeration

obtained and 1,500 lb. of low pressure revert gas returned to the first stage compressor. In actual operation 10 to 20 percent of CO₂ gas is lost in the process; consequently this loss must be deducted from the 1,500 lb. shown on the flow sheet as coming from the solid CO₂ press.

TERNARY CYCLE

This cycle (Fig. 2) utilizes the combination of two three-stage compressors without ammonia cooling. One compressor handles raw CO₂ gas and the other, revert gas.

Raw CO₂ from the gasometer saturated at 90 deg. F. passes through a precooler

where the cooling medium, expanded CO₂, reduces the temperature to 40 deg. F. Then it enters the first stage compressor, raising the pressure to 75 psi. abs. The temperature of the compressed gas is lowered to 40 deg. F. in a water and CO₂ cooled intercooler before it passes into the purification system. Temperature of the gas is raised slightly to approximately 50 deg. F. From here the CO₂ gas enters the suction port of the second stage compressor and discharges at a pressure of 350 psi. abs. Water and CO₂ cooled intercoolers lower the temperature after the first and second stage compressors condense some of the water and vaporized lubricating oil. A desiccant dryer placed after the second stage intercooler removes sufficient water to prevent freezing of the valves.

The final compression is carried out in the third stage compressor to 970 psi. abs. Then the gas is cooled in an aftercooler and liquefied in the condenser at 80 deg. F. (Critical temperature is 88.43 deg. F.) As the purity of the gas is not 100 percent it has been found advantageous to provide a purger for the removal of air and noncondensable gases.

Liquid CO₂ from the receiver now passes into two step-by-step flash coolers. In the first, the temperature is lowered to 20 deg. F. and in the second, to -40 deg. F.

In order to assure a uniform size of solid CO₂ block, a measuring tank is placed between the last flash cooler and the press. A predetermined amount of liquid CO₂ is fed

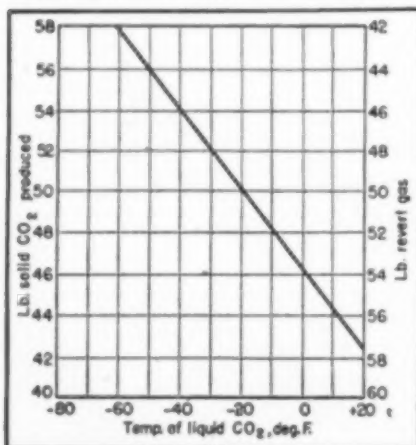
to the press, and the CO₂ vapors given off are utilized for precooling the liquid CO₂, going to the flash coolers. All the revert gases from the intercoolers, flash coolers, and the press are led to the three-stage recycling compressor, where the gases are recompressed. Part of the revert gas passes to the first stage, part to the second, and the combined revert gases are finally compressed to 970 psi. abs. This gas is then combined with the raw CO₂ of the same pressure.

FLASH CONDENSATION CYCLE

According to this process (Fig. 3), developed by the author (U. S. Patent 2,145,130), the aim was to reduce the size of the purification system and eliminate recompression of the large volume of revert gas. The principle of this cycle is to subject the liquid CO₂ to several adiabatic evaporative cooling operations in flash tanks and reliquefy the flash gases. Consequently the only revert gas in this system is obtained from the solid CO₂ press.

Raw CO₂ gas, either direct from the gasometer or after passing through a low pressure booster compressor, is combined with the revert gas received from the solid CO₂ press. These combined gases at zero deg. F. are led to the three-stage compressor, where the final pressure is approximately 1,020 psi. abs. After cooling the gas below its critical temperature, the liquid CO₂ thus obtained is flashed off in successive steps until a temperature of -40 deg. F. and a pressure of

Fig. 4—Effect of temperature on yield of solid CO₂ from "snow" press



147 psi. abs. is reached. The gaseous CO_2 given off during the flashings is condensed in ammonia cooled coolers and the reliquified gases combined with the cooled liquid CO_2 and passed from one flash tank into the other. Thus 1,000 lb. of liquid CO_2 from the compressor's third stage will be flashed, cooled, and recondensed, so that the original 1,000 lb. of CO_2 will reach the snow press at -40 deg. F.

SOLIDIFYING CARBON DIOXIDE

Regardless of the method used for cooling liquid CO_2 , the temperature should be low, so as to yield the highest percentage of solid CO_2 . When liquid CO_2 is expanded in the press, only a certain proportion will be converted to solid, the remainder reverting to gas which must be recompressed. However, as shown in Fig. 4, the yield varies greatly depending upon the temperature at which liquid is injected into the press.

To convert liquid into solid, specially designed hydraulic presses are used (Fig. 5). They are made in different sizes, producing either a $10 \times 10 \times 10$ or a $20 \times 20 \times 10$ in. block. The latter press produces one block every 10 min., or 1,320 lb. per hr. Older designs are provided with an accumulator for smoother operation; the latest designs use one low pressure rotary pump and one high pressure pump. The former exerts 450 psi. and is used to start the press and close the compression chamber. The latter exerts 2,500 psi. and is used to complete the operation.

After the square, well insulated snow chamber has been hermetically sealed by raising the lower ram, a predetermined amount of air-free liquid CO_2 is admitted. The amount of liquid required to produce a 220-lb. cake can be determined from its temperature and Fig. 4. This amount is metered either by measuring the quantity as in Fig. 2, or by timing with a clock for several minutes, or by automatic time-cycle control for the whole pressing operation.

When the liquid CO_2 is charged, the pressure is lowered near the triple point, that is, the point at 75 psi. abs. and -70 deg. F. where CO_2 exists simultaneously as liquid, solid, and gas. The revert, or blow-back, gas given off during flashing of the liquid in the snow chamber is carried away at 60-70 psi. After the right amount of solid CO_2 has been formed, the liquid feed is discontinued and the pressure released until it drops to zero. The snow thus formed is converted to a dense solid block by lowering the upper ram under 2,500 psi. and holding this pressure until the block has been compressed to the desired 10-in. thickness. Then the bottom ram is lowered and the block ejected by the upper ram.

For large scale production mechanically operated roller conveyors are attached to the press. The large 220-lb., $20 \times 20 \times 10$ -in. blocks are quartered by band saws producing four $10 \times 10 \times 10$ -in. cakes, each weighing 55 lb. These are wrapped in kraft paper bags and either shipped direct or stored. Some manufacturers prefer to store them in shipping boxes, others load them on skids

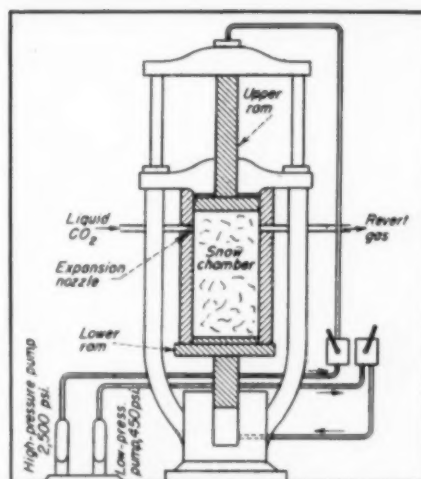
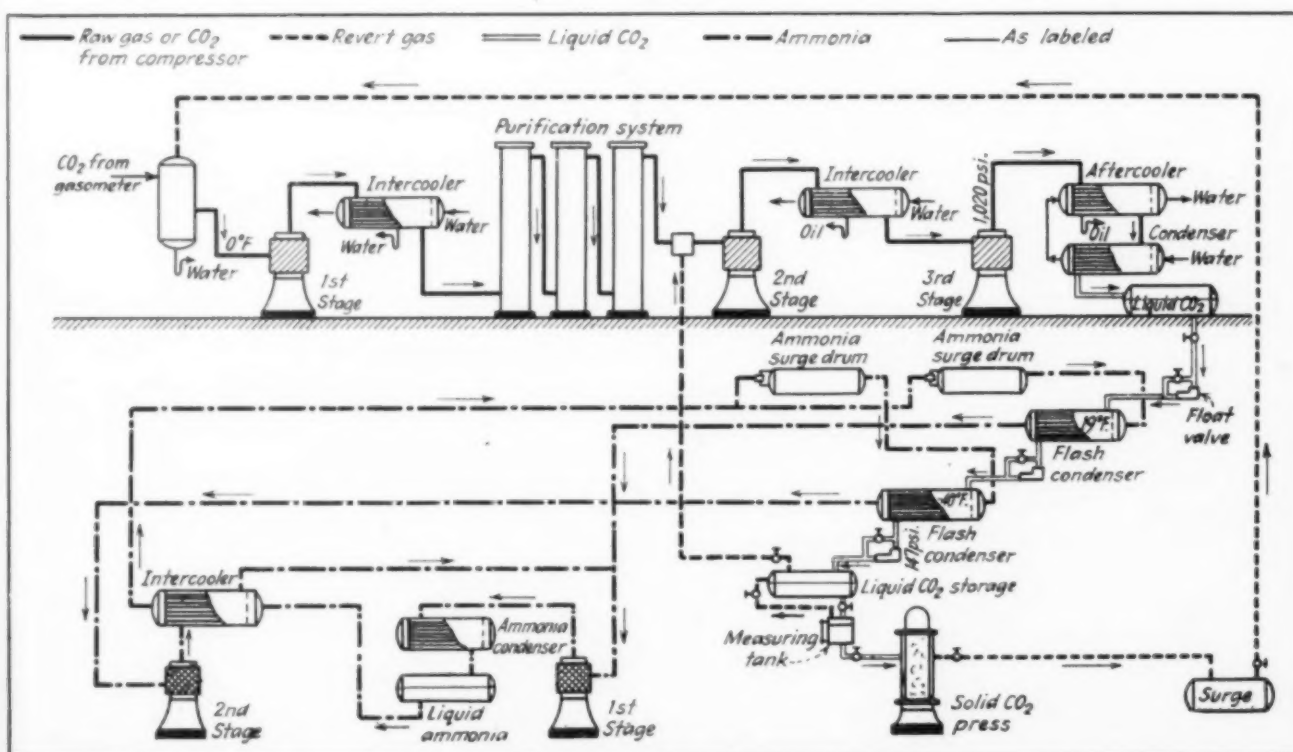


Fig. 5—Cross section of CO_2 press

and lower them into a well insulated pit, and still others store them in "regenerators" (C. L. Jones, *Ind. and Eng. Chem.*, 23, 798, 1931), which are vessels 40 ft. dia. and 80 ft. high and from which the gas given off during storage can be recovered. Storage in pits has the advantage that, CO_2 being 50 percent heavier than air, no air infiltration can take place and consequently the sublimation loss is held to the point where it is almost negligible.

The author wishes to thank W. H. Magee of the Worthington Pump and Machinery Corp. and L. R. St. Onge of the York Corp. for supplying data for this article.

Fig. 3—Flash Condensation Cycle avoids much recompression of revert gas in producing cold liquid CO_2



Control Occupational Hazards Through INDUSTRIAL HYGIENE

Often neglected in plant operations is the control of environmental conditions which adversely affect the health and efficiency of plant personnel. While most chemical engineers are aware of some of these hazards, their critical relation to employee productivity is not always apparent. The purpose of this article is to emphasize the importance of such hazards and to show how the application of industrial hygiene methods can help increase efficiency by protecting workers from undesirable conditions of atmospheric contamination.—Editors

MANY articles appear in the literature telling how to get more out of motors, power trucks, lubricants, wire cables, and other pieces of plant equipment. Most of these suggest greater equipment efficiency through various types of maintenance. In the modern industrial plant, however, there are two such problems which are equally important: the maintenance of machines and physical facilities, and the maintenance of manpower. Without equipment in proper operating condition the production of finished goods is retarded. Likewise, unless the manpower responsible for operating the machinery is in its highest state of productive ability, the total output of the combination of man and machine will fall below the desired level. In most plants the maintenance of equipment is considered an important factor in the general production schedule. Unfortunately, this is not so true of the maintenance of manpower. In many companies little thought is given toward this factor which should be integrated into the general scheme of plant operations in order to insure maxi-

mum and uninterrupted production at a minimum cost. Maintenance and conservation of manpower can be accomplished through application of industrial hygiene.

Many of the process industries, due to the nature of operations and materials employed, have occupational hazards which directly affect the health of the man on the job, and, in turn, his ability to produce.

One example of particular interest is the combination of toxic gases present in certain aluminum foundries. Here, hydrogen gas, formed by reaction of aluminum and oxygen in water, is removed by passing chlorine through the molten metal so that hydrogen and chlorine combine to form hydrochloric acid. Excess chlorine discharges to the atmosphere. At the same time, where melting pots are heated with unvented gas burners, carbon monoxide may be present in harmful concentrations and in the presence of chlorine may readily form phosgene. Thus, around melting pots operated in this manner the danger is threefold, from carbon monoxide, chlorine and phosgene. Toxic concentrations have actually been found in the atmosphere surrounding these operations.

WHOSE RESPONSIBILITY?

Generally, many of the environmental hazards are well known to chemical engineers; the accompanying table, however, lists some of the common industrial materials which are toxic, giving physiological properties, safe tolerances, and some processes in which they occur. It is the presence of these and similar contaminants which are of primary concern to the production man in his problem of manpower maintenance.

In a program for the maintenance of manpower, two approaches suggest themselves. These are medical and engineering. The medical approach deals with the individual and his physical capacities and limitations; the engineering approach is concerned with the working environment as it affects the employee and his productive ability. The average working man spends roughly one-third of his time on the job, so that his

surroundings while at work influence his well-being and definitely are reflected in his ability to produce.

Since processing methods, equipment, and materials to a large extent determine the nature of the working environment, they must be considered from the standpoint of employee health. This, then, is the responsibility of the plant or production engineer who usually has the most intimate knowledge of methods and materials and should be in position to know where danger spots exist. Some plants have no personnel with engineering background, others have general plant engineers, chemical engineers, electrical engineers, and safety engineers, but few have industrial hygiene engineers with the combined know-how for the control of both occupational diseases and occupational accidents, including practical experience in the maintenance of production.

In most plants, safety men are primarily concerned with the mechanical aspects of processing and equipment operation as they affect accident experience. In general, these men are not trained in methods necessary for the investigation and evaluation of occupational exposures arising from the presence of toxic materials in the atmosphere, and in many cases are not familiar with the toxic effect of such materials. Often this vital phase of environmental control is neglected. Since this is true, it is well for such plants to utilize the services of official industrial hygiene bureaus or departments. By doing this, they can obtain impartial surveys and expert consultation. Specialists from these bureaus can make detailed surveys, work out corrective measures, and assist plant men in their application.

INDUSTRIAL HYGIENE SURVEY

The industrial hygiene survey is a means by which the plant is studied department by department and occupational hazards and unsafe practices are located and appraised. Such a survey includes: (1) An evaluation of occupational hazards and unsafe practices, (2) work analysis noting toxic or hazardous materials or physical conditions to which each worker is exposed, (3) an-

alytical procedures to determine whether a potential exposure or hazard is real, (4) rating of the hazards and of existing corrective measures, (5) analysis of observations and findings and recommendations for control measures, and (6) follow-up to assist the plant engineer in carrying out recommendations and providing checks on efficiency of such recommendations.

The work analysis and evaluation of occupational hazards is done by noting every job carried out in the plant, method of processing, and hazardous materials or conditions to which each and every worker is exposed. Toxic materials when present are investigated from the standpoint of their liberation into the atmosphere, physical state, whether or not the employee is required to be in the immediate area where the material is dispersed, and the like.

Analytical procedures usually involve field collection of samples followed by analysis in the laboratory. Such samples are generally taken from the breathing zone of the exposed employee, and should be collected in such a manner as to indicate average operating conditions. It is sometimes desirable to collect spot samples to show peak or other special conditions. It is only through actual sampling of the atmosphere and analysis

that an accurate evaluation of the exposure can be obtained. Many toxic materials make their presence known by odor and other properties, but these properties do not offer quantitative methods for determining their concentrations.

CONTAMINATION YARDSTICK

The rating of a hazard is the application of a yardstick to determine the degree of the exposures and the efficiency of corrective measures which might exist. For many specific compounds threshold values have been established and by comparing the length of time the employee is exposed, the degree of exposure, and other factors, it is possible to determine the extent of the hazard.

An analysis of processing methods, rating of hazards, and efficiency of existing corrective measures, serves as a baseline for recommendations for additional control measures if these are indicated. Actual processing procedures in most cases will determine the type of control necessary.

When the industrial hygiene study has been completed and observations and recommendations presented in the form of a report, it is desirable that this be followed up in order to assist the plant in carrying out



Courtesy W. W. Sig Co.

Local exhaust ventilation prevents dust contamination on the charging floor of this chemical plant

recommendations and in investigating efficiency of control measures as they are applied. This is of particular value if the plant does not have its own engineering or other technical personnel. In any case, the follow up is necessary in order to complete the service.

In addition to engineering personnel available for industrial hygiene surveys, trained industrial physicians are available to assist the plant medical department in correlating engineering findings with the medical program. Engineering measurements indicate potential and actual exposure while medical findings indicate the degree to which the individual workers may be affected by exposures. In presenting the picture of the occupational exposures, completeness requires correlation of both engineering and medical data.

CONTROL PROCEDURES

Occupational hazards, as determined by an industrial hygiene survey, can either be eliminated or reduced to harmless limits by the application of proper control methods. Procedures for the control of these exposures usually consist of one of the following:

Isolation of the process or operation. Where this is done, an operation is removed from the general work area and located in a position such that the minimum number of employees will come into the sphere of contamination. This may be done by locating the operation in an outside room or some place where it may be closed off. Although this approach is occasionally used, it has its limitations.

Wet methods may sometimes be used on grinding, crushing, and similar operations. Where the stock being processed must be

Selected Toxic Processing Materials With Safe Concentrations and Symptoms of Injury

Toxic Material	Products, Processes and Industries With Potential Hazards	Safe Atmospheric Concentration	Physiological Effects of Exposure
Ammonia	Organic preparations; refrigeration; bronzing; dye and color mfg.; sugar refining.	100 p.p.m.	Irritation of respiratory passages, coughs, pulmonary edema, severe eye irritation, caustic action on skin.
Amyl acetate	Mfg. of solvents; paints; lacquers; soap, etc.	400 p.p.m.	Irritation of mucous membranes of eyes, nose, throat; headache and vertigo, fullness of head, drowsiness, oppression in chest, cough, nausea.
Acrolein	Organic synthesis; mfg. military gases; soap and varnish; fertilizer.	1.0 p.p.m.	Irritation of skin and mucous membranes of eyes and respiratory tract, dyspnea, bronchitis.
Aniline	Organic synthesis; dye mfg.; paint and varnish; disinfectants; explosives.	5.0 p.p.m.	Muscular weakness, vertigo, cyanosis, fainting, nervous symptoms, loss of equilibrium, nausea, vomiting, diarrhea.
Benzol	Solvent; paint and varnish removers; dye; varnish mfg.; rubber industry.	100 p.p.m.	Headache and vertigo, gastro intestinal disturbances, hemorrhages, injury to blood forming organs with changes in blood picture, injury to blood vessels, heart, liver, kidneys, etc.
Carbon bisulfide	Solvent; mfg. viscose rayon; varnishes; insecticides; carbon tetrachloride.	20 p.p.m.	Headache, vertigo, weakness, mental disturbances, irritation of skin.
Carbon monoxide	Mfg. iron and steel; enamel; illuminating gas; kiln operations; smelting.	100 p.p.m.	Headache, painfulness of eyeball, throbbing of temples, weakness, nausea, vomiting, increased respiration and pulse, collapse.
Carbon tetrachloride	Solvent; mfg. cleaning compounds; dye; paint and lacquer industries.	100 p.p.m.	Irritation of nose, throat and eyes, nausea, headache, vomiting, confusion, narcosis, injury to liver, dermatitis.
Chlorine	Organic synthesis; textile bleaching; water purification; chlorination.	1.0 p.p.m.	Acute cardiac paralysis, burning, blistering, cough, bronchitis, chronic anemia, nasal and bronchial catarrh.
Hydrogen chloride	Leather industry; organic synthesis; dye stuffs; mfg. chlorides.	10 p.p.m.	Coughing, bronchitis, destruction of teeth, contraction of throat, caustic action on skin.
Hydrogen fluoride	Ceramics; fertilizer; and phosphate.	3.0 p.p.m.	Conjunctivitis; ulceration of the nostrils, gums, caustic action on skin.
Hydrogen sulphide	Reagent; analytical chemistry; viscose rayon spinning; leather tanning, mining and smelting; paper mfg.	20.0 p.p.m.	Conjunctivitis, exhaustion, pallor, pain in eyes, nose and throat; headache, convulsions, paralysis.
Nitro-benzene	Perfumes; mfg. aniline, inks, explosives; gasoline blending.	5.0 p.p.m.	Headache, vertigo, nausea, vomiting, unsteady gait, nerve injury, anemia.
Nitrogen oxides	Organic synthesis; mfg. dye-stuffs, drugs, explosives, celluloid, metallurgy.	40 p.p.m.	Irritation of air passages, cough, pulmonary edema, bronchitis, corrosion of teeth, skin burns.
Sulphur dioxide	Bleaching; cellulose and paper industry; mining and smelting.	10 p.p.m.	Bronchitis; irritation of eyes and respiratory tract, digestive disturbances, inflammation of lungs.
Toluol	Solvent; paint and varnish removers; organic preparations; dye mfg.; rubber industry.	200 p.p.m.	Headache and vertigo; narcosis, gastrointestinal disturbances—acute poisoning show inebriation, staggering gait, convulsions and loss of consciousness.
Chromium compounds	Dyes; metallurgy; electroplating; prep. chromium salts, tanning.	0.1 mg. per cu.m. of air	Bronchitis, broncho pneumonia, conjunctivitis, eczema, ulcers of the skin and mucous membranes and perforation of the nasal septum.
Lead	Chemical equipment, lead pigments; alloys; storage battery mfg.; insecticides.	0.15 mg. per cu.m. of air	Weakness, pallor, loss of appetite, lead line, anemia, constipation, cramps, colic.
Mercury	Prep. mercury salts, scientific instruments, chemical processing.	0.1 mg. per cu.m. of air	Inflammation of gums and mucous membrane of the mouth, necrosis of the jaw, enteritis, anemia, tremors of the hands and face.

Natural Gas Utilization In the U.S.*

G. B. OBERFELL

Phillips Petroleum Co.
Bartlesville, Okla.

AN EXAMINATION of the past and present uses of natural gas clearly indicates its superior qualities for fuel purposes. While considerable quantities are employed in carbon black plants, nevertheless such use disappears when higher priced markets and pipeline outlets become available. The future prospects of the use of natural gas for fuel purposes are very bright. It is expected that as more value is placed upon this commodity and transportation facilities are increased, less natural gas will be used in the present low priced markets.

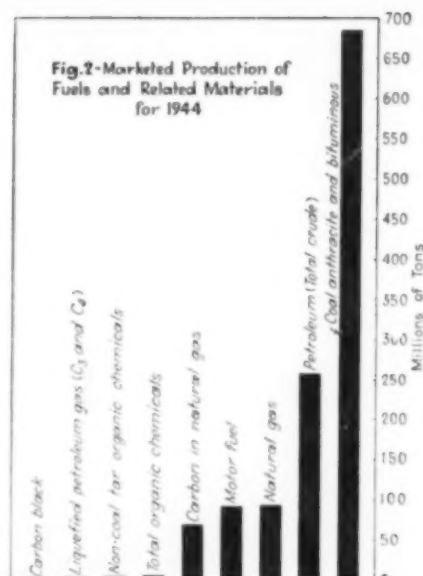
Natural gas as a raw material in the manufacture of chemicals is of considerable economic importance to the chemical industry, but the quantity of natural gas used for producing chemicals is and probably will continue to be relatively small in comparison to the amount used for other purposes.

Natural gas is a more economic raw material than coal for conversion to liquid hydrocarbons by the Fischer-Tropsch process. Modifications of the Fischer-Tropsch process, using natural gas, will undoubtedly

find useful applications, particularly where the process can be combined with other processes or with existing facilities. The production of natural gasoline and the manufacture of chemicals afford opportunities for such combinations. However, without the economic advantages of such combinations, the available information indicates that as a means of producing gasoline alone the Fischer-Tropsch process would not be competitive with present refinery operations, using crude oil as a raw material, under present prices. Furthermore, the peak of gasoline production from natural gas by the Fischer-Tropsch process will undoubtedly amount to only a minor proportion of the total gasoline supply of the nation. Our appraisal of the commercial possibilities of converting natural gas to liquid fuels, on the basis of our own research and results reported by others, leads us to be more optimistic than is warranted by any conclusive published data.

Natural gas and petroleum reserves are larger today than at any other time in our history, despite the fact that our recent consumption rates have been at an all-time peak. There is no cause for alarm concern-

ing the early exhaustion of our petroleum and natural gas resource. It is believed that there are more chances of research and development finding entirely new sources of energy or using the available energy in a radically



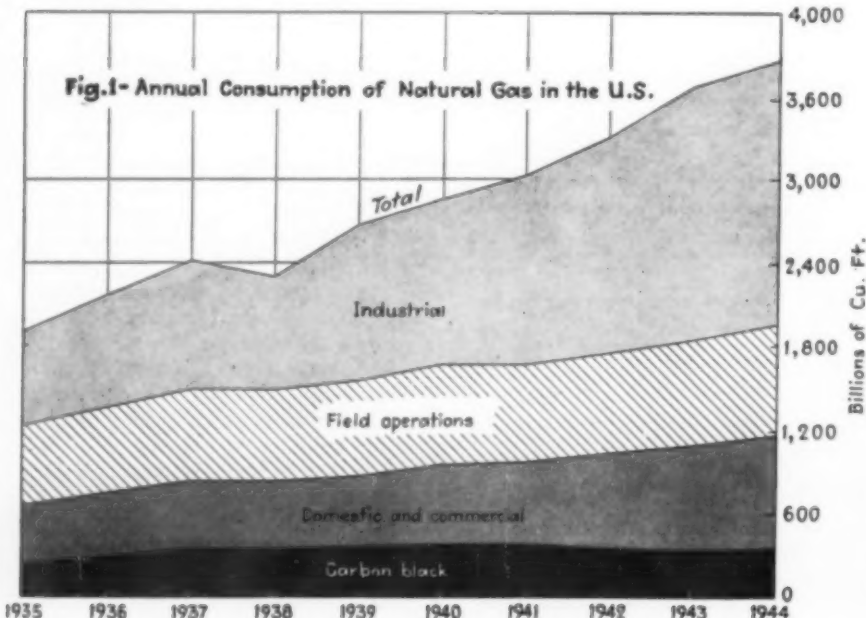
Marketed Production of Fuels and Related Materials for 1944

	Weight, Thousands of Tons	Heat Value, Trillions of Btu's	Volume, Billions of Cu. Ft.	Volume, Thousands of Bbl.
Total coal (anthracite and bituminous)	683,315	17,967		
Petroleum (total crude) ¹	257,198	10,096		1,077,744
Natural gas ²	92,535	4,115	3,829	
Motor fuel	92,232			732,000
Carbon in produced natural gas	69,416			
Total organic chemicals ³	7,000			41,667
Non-coal tar organic chemicals ³	5,000			29,762
Liquefied petroleum gas ²	2,160	89	29	21,562
Carbon black ²	400			

¹ Survey of Current Business, March 1945.
² Bureau of Mines. ³ Chem. & Met., Feb. 1945, p. 130.

Marketed Production of Liquid Petroleum Gas, Gal.

Year	Total Sales	Domestic	Industrial and Misc.	Gas Mfg.	Chemical Mfg.
1934....	56,427	17,681	32,448	6,298	.....
1935....	76,855	21,390	47,894	7,581	.....
1936....	106,652	30,014	67,267	9,371	.....
1937....	141,400	40,823	62,610	11,175	26,792
1938....	165,201	57,832	62,694	12,386	32,299
1939....	223,580	87,530	93,723	15,435	26,892
1940....	313,456	134,018	124,482	20,285	34,671
1941....	462,852	220,722	172,609	25,255	44,206
1942....	585,440	229,559	201,447	31,366	53,038
1943....	675,233	339,380	242,978	37,519	55,356
1944....	906,600	438,552	267,295	47,768	151,985



different way than that in which gasoline is now being used, than there is that our petroleum resources will be exhausted within the next one hundred years. However, intelligent use of petroleum resources is required in order that there may be adequate supplies for use in any national emergency. Research and development work on more efficient conversion and utilization of liquid fuels from petroleum, natural gas, coal, and agricultural products should be continued.

Annual Consumption of Natural Gas in the U. S., Billions of Cu. Ft.¹

Year	Industrial ²	Domestic and Commercial	Field ³	Carbon Black	Total
1935	674	414	580	242	1,910
1936	804	455	615	283	2,161
1937	921	489	651	341	2,403
1938	828	482	659	325	2,294
1939	1,127	509	681	347	2,665
1940	1,179	678	712	388	2,958
1941	1,372	587	712	388	3,010
1942	1,545	682	721	336	3,284
1943	1,820	745	760	316	3,641
1944 ⁴	1,598	810	792	328	3,528

¹ Bureau of Mines. ² Monthly Summary of Gas Co. Statistics, April 1945, American Gas Assn. ³ Includes petroleum refineries, power plants, cement plants, chemical and other industrial uses. ⁴ Includes gas used to generate power for drilling, pumping and reconditioning gas wells.

REACTIVATION

Of Adsorbent Desiccants

Direct calculation cannot possibly take into account all the interrelated phenomena accompanying adsorbent desiccant reactivation. Mr. Ledoux, author of a recent book on vapor adsorption, presents here a brief article pointing out some of the complicated aspects of the process.—Editors

REACTIVATION, also termed regeneration or revivification, consists in the elimination of adsorbates from an adsorbent, that is to say, the substances previously taken up. Those adsorbates that are non-volatile or have unduly high boiling points must be burned out or solvent extracted and in many cases, complete reactivation is not possible.

In the particular case of desiccants treating clean gases, water is the only substance involved. Since it is quite volatile, it can be desorbed, or driven off in other words, by evaporation. Reactivation, therefore, comes to mean drying the adsorbent by means of a current of hot gas at atmospheric or higher pressure.

This dynamic desorption is unfortunately much more complex than is immediately apparent and a brief review of the several factors controlling the process will serve to show that it is not possible to determine accurately the desorption time by any simple calculation.

Rate of reactivation increases with the flow of gas by weight, efficiencies of vapor and heat transfer, and difference between the vapor pressure of the adsorbate and that in the gas. Not only are these variables influenced to a considerable extent by other circumstances of the process, but they are also dependent upon one another. For instance, doubling the flow will not double the rate because of the consequential drop in the efficiencies. In other words, the greater the flow, the less moisture evaporated and taken up per pound of gas.

Efficiencies are also a function of the

total outside surface of adsorbent granules; they increase with the fineness of mesh. Another important factor controlling the efficiency is the coefficient of transfer. Both coefficients are, for a given gas, characteristic of the adsorbent and the shape of its granules. Since, in any case they increase with the velocity of flow, the rate of desorption for a given amount of desiccant will be greater for a deep bed than for a shallow one and for operation at low pressure. As the vapor must diffuse inside the granules before it can reach their outer surface where it is taken up by the gas, the coefficient of vapor transfer decreases with the concentration in the desiccant. On the other hand, the coefficient of heat transfer increases with both temperature and humidity of the gas. Therefore, both coefficients vary continuously with time and also with the location in the bed.

On account of the cooling effect produced by evaporation, the temperature of the adsorbate is lower than that of the reactivation gas. Nevertheless, the higher the temperature of the gas, the greater the vapor pressure of the adsorbate and the rate of desorption. This function is not linear, and in general practice it is hardly worth while to exceed about 400 deg. F. at inlet.

Vapor pressure of the adsorbate as well as the coefficient of vapor transfer decreases with concentration and, since it varies with temperature, it also changes continuously with time and location. The same applies to the heat of vaporization of the adsorbate which increases as vapor pressure decreases.

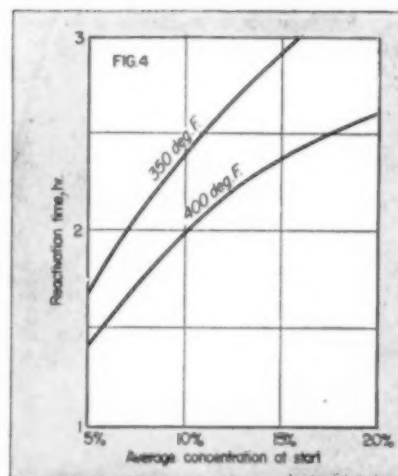
Even at the start, the distribution of moisture in the bed is not uniform because in practice the previous adsorption process is never continued to complete saturation of the charge but is stopped shortly after the adsorption break point has been reached. The concentration is always higher at the end of the bed where the gas to be dried was previously admitted but the actual shape of the initial concentration curve depends upon both the flow and conditions of the gas dried previous to reactivation (Fig. 1). Therefore, if the direction of reactivation flow is the same as that previously used for adsorption, the greater part of the desorbed

moisture will have to travel down the bed before leaving it. As the temperature of the air and, therefore, that of the adsorbent decreases considerably in the direction of flow, the vapor pressure of the adsorbate in the outlet layers is sufficiently low for them to adsorb from the gas some of the moisture desorbed from the high temperature layers. This moisture must then be desorbed again later. The effect is greater for higher previous adsorption flows and it is preferable to avoid it by counterflow reactivation; other design considerations will, however, not always permit this. The temperature variation in a 6.9-in. bed at time intervals of from 5 to 127 min. is shown on Fig. 2.* Adsorption in the outlet layer causes the temperature rise shown in that area. The resulting shape of the curve for outlet temperature vs. time is shown by A in Fig. 3. This is typical of non countercurrent reactivation. Curve B is the typical shape for countercurrent operation when no adsorption takes place if any reasonable insulation has been provided.

Adsorption during reactivation will also occur unless dry gas is used if the desorption flow is so low that the initial heating period is too long. Until the bed has been brought up to temperature, the vapor pressure of the adsorbate is low enough to cause drying of the activation gas because the previous adsorption run was cut off long before the adsorbent was completely spent. Apart from this detrimental effect, the time required with very low rates of flow increases and, therefore, the total radiation loss also. A good economical rate with atmospheric air is 0.4 cfm. per lb., although higher rates may be used if economy is secondary to rapidity of reactivation.

In an adiabatic humidifier, the temperature of the water, which is the wet-bulb temperature, increases with the inlet vapor pressure of the gas treated. In the case of desorption, the temperature and, therefore, the vapor pressure of the adsorbate, also increases with the inlet vapor pressure of the gas for similar reasons and the outlet dew-point rises. If both vapor pressures increased by exactly the same amount, their

* Adapted from E. Ledoux, "Vapor Adsorption, Industrial Applications," Chemical Publishing Co., Brooklyn (1946).



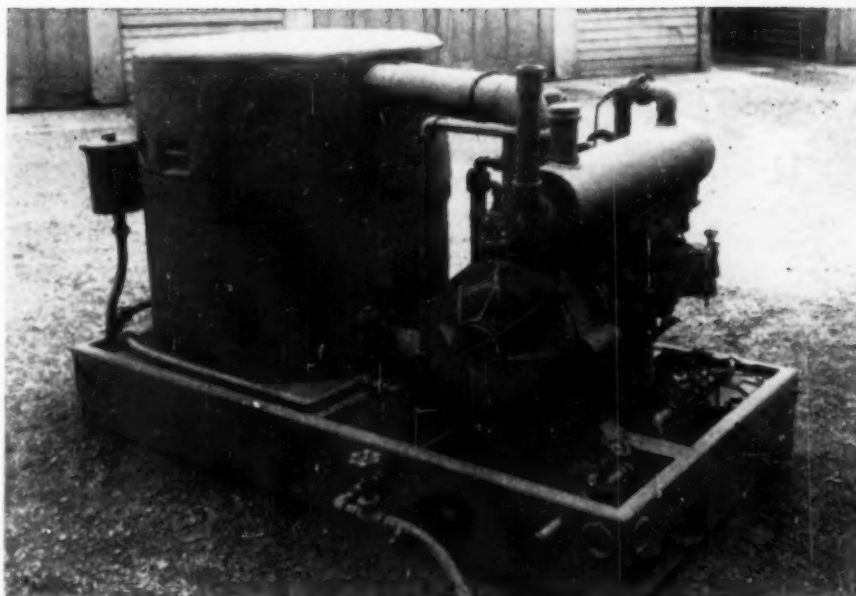
• JANUARY 1946 • CHEMICAL & METALLURGICAL ENGINEERING

VAPOR RECOMPRESSION as a means of supplying heat energy for evaporation and distillation operations is an old idea that aroused considerable interest in the past, but without any very lasting effects. Nevertheless, the idea came back in a special wartime application, that of providing distilled drinking water for military personnel, and accomplished this function so successfully that the method is likely to find important postwar use in a limited, though considerable, class of applications. Apparently its field lies in evaporations where there is little "boiling point elevation." Water distillation and the "condensing" of food products such as milk and sirup appear to be typical of its sphere of use.

The idea involved in vapor recompression distillation is simple enough although lack of suitable equipment and a proper understanding of its limitations severely handicapped the scheme in its early days. To evaporate a pound of water at any given pressure requires a certain number of heat units, and this same number of units will be given up when the vapor condenses, provided it does so at the same pressure. Thus, if it were not for losses and the need for a temperature potential between condensing vapor and boiling liquid, water could be made to evaporate itself continuously, once the process was started. An obvious way to provide the energy to overcome losses, and at the same time create the necessary temperature potential, is to compress the vapor from the boiling liquid, thereby raising its temperature and pressure, then using the vapor to boil more liquid. The latter provides the heat sink for condensing the vapor. Heat exchange facilities for preheating the feed by cooling the condensate complete the picture.

Apparently the first recorded case where this scheme was attempted was in 1856. Several other attempts were made during the latter part of the 19th century. Numerous efforts were recorded in Europe during the period from 1900 to 1925 and there was a flurry of interest in the United States in the early 1920's. Some of the European attempts seem to have succeeded technically, although the economics is doubtful. Two methods for compression of the vapor were employed in the main, steam jets, and

By the end of World War II the capacity of Kleinschmidt vapor recompression evaporators for distilled water in use by the Armed Services was enough to supply the needs of more than a million men. Several thousand units were in use, giving a fuel economy of about 175 lb. of distilled water per pound of fuel used.—Editors



1,800 g.p.d. portable compression distillation unit for seawater

Water Distillation Makes Successful Use Of Vapor Recompression

EDITORIAL STAFF

elaborate and expensive centrifugal compressors. Aside from equipment expense and inefficiency, the chief stumbling block seems to have come from the attempt to use the process where too great an increase in vapor temperature was needed.

MODERN VERSION

Shortly before the war, R. V. Kleinschmidt, associated with Arthur D. Little, Inc., developed the idea of using this principle in the distillation of seawater for Navy use. Dr. Kleinschmidt reasoned that little increase in vapor temperature would be necessary since the boiling point elevation is slight. Therefore it should be possible to use moderate cost compression equipment of cycloidal or other simple type. The idea worked and Dr. Kleinschmidt was about to describe it before a technical society when the Navy clamped on security regulations. First publicity for the method was permitted in a paper presented by Allen Latham, Jr., of Arthur D. Little, Inc., before the Power Division of the American Society of Mechanical Engineers on Nov. 28. Mr. Latham had carried on wartime development of the Kleinschmidt still while Dr. (later Commodore) Kleinschmidt was serving with the Navy.

As developed for the Armed Forces by the Little organization, and built by E. B. Badger & Sons Co., the Kleinschmidt still is decidedly simple. A portable type such as that used on land by the Army and Marine Corps, appears in the accompanying illus-

tration. It is powered by a gasoline engine and has a capacity of 1,800 g.p.d. of distilled water from seawater. It consists of an evaporator body containing in addition to its vertical-tube steam chest a starting coil to bring the charge to boiling temperature initially by means of an external heat supply. Feed, condensate and the discharged concentrated brine are led through the passages of a three-way heat exchanger to transfer the bulk of the heat in the latter two components to the feed. Steam, released from the boiling brine at about 212 deg. F. is compressed by a rotary compressor to about 3 lb. ga. and a temperature of 222 deg. F., discharging to the steam chest vapor space where it condenses by boiling the brine at 213 deg. F. Condensate at 221 and brine at 213 deg. leave by way of the triple-passage heat exchanger and preheat the incoming seawater to 207 deg. F. Approximately 1 lb. of fresh water is produced from 1.25 lb. of seawater, at the expenditure of the equivalent of 20 watts energy at the compressor. Figuring in engine efficiency, this is stated to represent an over-all efficiency of 175 lb. of distillate per pound of fuel. Expressed differently, since a single-effect evaporator would require about 300 watts per pound, the compression evaporator is equivalent to approximately a 15-effect evaporator.

An important advantage claimed for vapor recompression as compared with multiple effect evaporation is the simplicity of the equipment and its operation. The connections, heat transfer arrangements and control are as simple as those for a single effect.

New Charts Record Vapor Pressures Of Inorganics Above 1 Atm.

ERNST BERL

Consultant
Pittsburgh, Pa.

Table II—Elements and Compounds Boiling in Various Temperature Intervals at 1 Atm. Pressure

Boiling Point Interval, Deg. C.	Substance Number (See Table I)
-270 to -260.1	15
-260 to -250.1	14
-250 to -240.1	29
-240 to -230.1	20
-230 to -220.1	7, 1, 30
-220 to -210.1	19
-210 to -200.1	26
-200 to -190.1	45, 31
-190 to -180.1	47, 4
-180 to -170.1	33
-170 to -160.1	25, 34, 44
-160 to -150.1	8
-150 to -140.1	6, 37, 39
-140 to -130.1	2, 36, 9
-130 to -120.1	43
-120 to -110.1	18, 11, 21
-110 to -100.1	35
-100 to -90.1	40, 28
-90 to -80.1	3, 10, 12
-80 to -70.1	27
-70 to -60.1	24
-60 to -50.1	41
-50 to -40.1	5
-40 to -30.1	13
-30 to -20.1	32
-20 to -10.1	22, 46
-10 to 0	17
0 to 10.1	23
10 to 20.1	16
20 to 30.1	42
30 to 40.1	38
40 to 50.1	48
50 to 60.1	
60 to 70.1	
70 to 80.1	
80 to 90.1	
90 to 100.1	
100 to 110.1	
110 to 120.1	
120 to 130.1	
130 to 140.1	
140 to 150.1	
150 to 160.1	
160 to 170.1	
170 to 180.1	
180 to 190.1	
190 to 200.1	
200 to 210.1	
210 to 220.1	
220 to 230.1	
230 to 240.1	
240 to 250.1	
250 to 260.1	
260 to 270.1	
270 to 280.1	
280 to 290.1	
290 to 300.1	
300 to 310.1	
310 to 320.1	
320 to 330.1	
330 to 340.1	
340 to 350.1	
350 to 360.1	
360 to 370.1	
370 to 380.1	
380 to 390.1	
390 to 400.1	
400 to 410.1	
410 to 420.1	
420 to 430.1	
430 to 440.1	
440 to 450.1	
450 to 460.1	
460 to 470.1	
470 to 480.1	
480 to 490.1	
490 to 500.1	
500 to 510.1	
510 to 520.1	
520 to 530.1	
530 to 540.1	
540 to 550.1	
550 to 560.1	
560 to 570.1	
570 to 580.1	
580 to 590.1	
590 to 600.1	
600 to 610.1	
610 to 620.1	
620 to 630.1	
630 to 640.1	
640 to 650.1	
650 to 660.1	
660 to 670.1	
670 to 680.1	
680 to 690.1	
690 to 700.1	
700 to 710.1	
710 to 720.1	
720 to 730.1	
730 to 740.1	
740 to 750.1	
750 to 760.1	
760 to 770.1	
770 to 780.1	
780 to 790.1	
790 to 800.1	
800 to 810.1	
810 to 820.1	
820 to 830.1	
830 to 840.1	
840 to 850.1	
850 to 860.1	
860 to 870.1	
870 to 880.1	
880 to 890.1	
890 to 900.1	
900 to 910.1	
910 to 920.1	
920 to 930.1	
930 to 940.1	
940 to 950.1	
950 to 960.1	
960 to 970.1	
970 to 980.1	
980 to 990.1	
990 to 1000.1	

Table III—Temperature Intervals in Which Highest Recorded Boiling Points of Various Substances Occur

(Italics Indicate Critical Data)

Boiling Point Interval, Deg. C.	Substance Number (See Table I)
-270 to -260.01	15
-260 to -250.01	14
-250 to -240.01	29
-240 to -230.01	20, 7
-230 to -220.01	1
-220 to -210.01	30
-210 to -200.01	26
-200 to -190.01	19
-190 to -180.01	4
-180 to -170.01	33, 44, 31, 45
-170 to -160.01	28, 2, 47
-160 to -150.01	36
-150 to -140.01	8
-140 to -130.01	25, 28, 24, 12
-130 to -120.01	36, 34
-120 to -110.01	10
-110 to -100.01	3, 5
-100 to -90.01	6
-90 to -80.01	59, 37, 9
-80 to -70.01	31, 43
-70 to -60.01	11
-60 to -50.01	18, 40, 37
-50 to -40.01	17
-40 to -30.01	41
-30 to -20.01	13
-20 to -10.01	46
-10 to 0	39
0 to 10.1	22
10 to 20.1	42
20 to 30.1	44
30 to 40.1	45
40 to 50.1	23
50 to 60.1	38
60 to 70.1	16
70 to 80.1	48
80 to 90.1	
90 to 100.1	
100 to 110.1	
110 to 120.1	
120 to 130.1	
130 to 140.1	
140 to 150.1	
150 to 160.1	
160 to 170.1	
170 to 180.1	
180 to 190.1	
190 to 200.1	
200 to 210.1	
210 to 220.1	
220 to 230.1	
230 to 240.1	
240 to 250.1	
250 to 260.1	
260 to 270.1	
270 to 280.1	
280 to 290.1	
290 to 300.1	
300 to 310.1	
310 to 320.1	
320 to 330.1	
330 to 340.1	
340 to 350.1	
350 to 360.1	
360 to 370.1	
370 to 380.1	
380 to 390.1	
390 to 400.1	
400 to 410.1	
410 to 420.1	
420 to 430.1	
430 to 440.1	
440 to 450.1	
450 to 460.1	
460 to 470.1	
470 to 480.1	
480 to 490.1	
490 to 500.1	
500 to 510.1	
510 to 520.1	
520 to 530.1	
530 to 540.1	
540 to 550.1	
550 to 560.1	
560 to 570.1	
570 to 580.1	
580 to 590.1	
590 to 600.1	
600 to 610.1	
610 to 620.1	
620 to 630.1	
630 to 640.1	
640 to 650.1	
650 to 660.1	
660 to 670.1	
670 to 680.1	
680 to 690.1	
690 to 700.1	
700 to 710.1	
710 to 720.1	
720 to 730.1	
730 to 740.1	
740 to 750.1	
750 to 760.1	
760 to 770.1	
770 to 780.1	
780 to 790.1	
790 to 800.1	
800 to 810.1	
810 to 820.1	
820 to 830.1	
830 to 840.1	
840 to 850.1	
850 to 860.1	
860 to 870.1	
870 to 880.1	
880 to 890.1	
890 to 900.1	
900 to 910.1	
910 to 920.1	
920 to 930.1	
930 to 940.1	
940 to 950.1	
950 to 960.1	
960 to 970.1	
970 to 980.1	
980 to 990.1	
990 to 1000.1	

Table IV—Pressure Intervals in Which Highest Recorded Boiling Points of Various Substances Occur

(Italics Indicate Critical Data)

Pressure Interval, Atm.	Substance Number (See Table I)
1-4.99	17, 24, 42, 12, 5
5-9.99	28, 38, 3, 10
10-19.99	4, 14, 36, 2
20-24.99	15
25-29.99	29
30-34.99	20, 23
35-39.99	7, 46, 13, 44
40-44.99	33
45-49.99	1, 45, 30
50-59.99	48, 19, 47
60-69.99	9, 37, 34, 31, 20
70-79.99	40, 5, 35
80-89.99	18, 25, 41, 6, 43, 39
90-99.99	11
100-149.99	27, 21, 22
150-199.99	16
200-249.99	32

IT HAS long been the author's belief that data recorded in chart form are among the most useful tools of the chemical engineer and chemist and that at present too many of the data are available only in widely scattered tabulations in the literature. It has therefore on many occasions been his effort to bring such data together and to record them in chart form for maximum convenience of use.

(See for example Dr. Berl's charts on pp. 132 and 133 of our Nov. 1944 issue, covering vapor pressures of many materials, largely below 1 atm.—Editor.)

The accompanying charts and tabulations represent such an attempt to assemble vapor pressure data of the most reliable character,

this collection covering 48 elements and inorganic materials. Table I is the key to the materials plotted on Figs. 1 and 2, listing the substances, and the coordinates for boiling points at atmospheric pressure, and at the highest pressure for which data are available. The arrangement is according to (Continued on page 133)

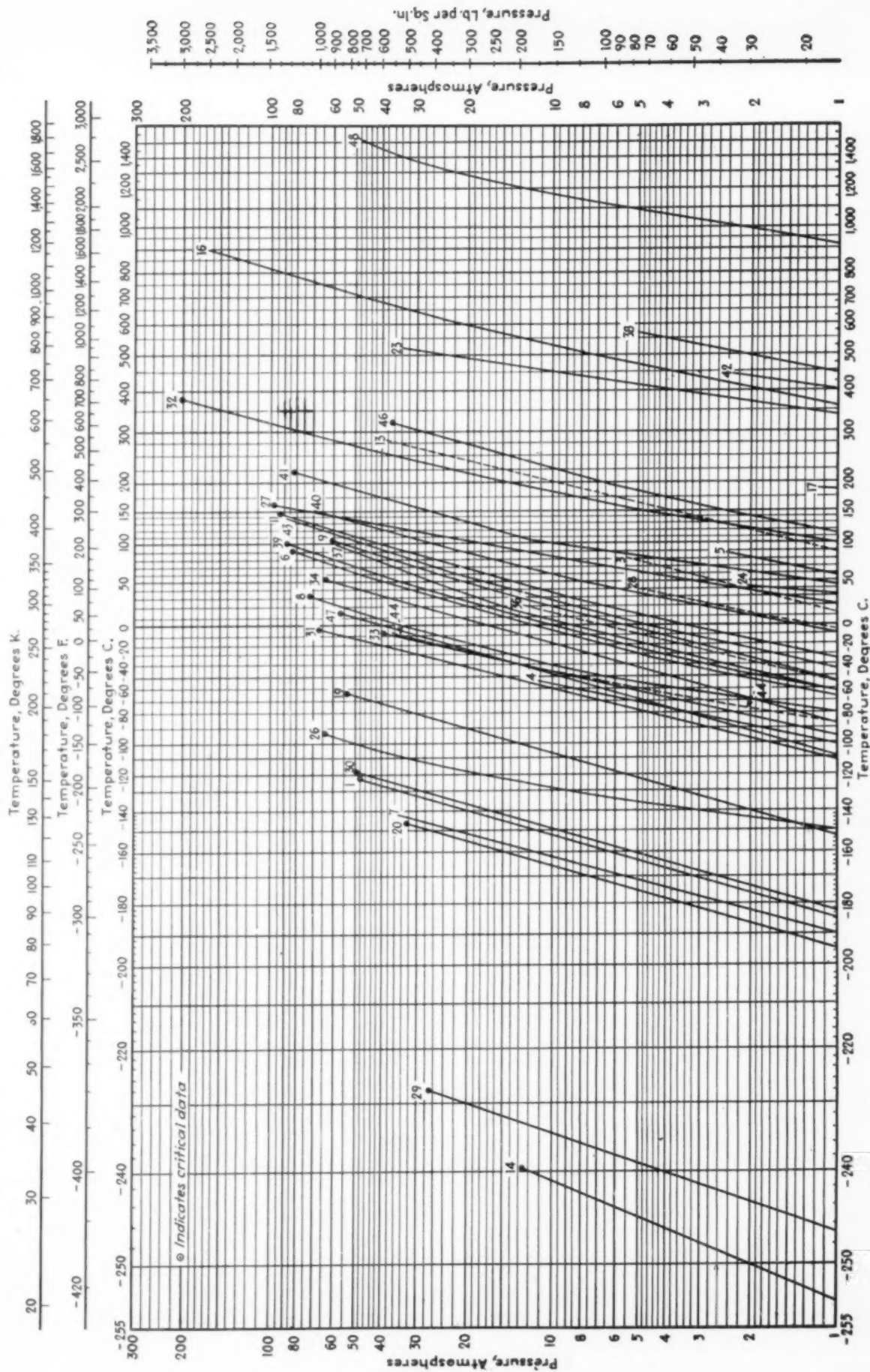
Table I—Boiling Points of 48 Elements and Inorganic Compounds at 1 Atm. and Vapor Pressures Above 1 Atm.

(Data in Italics Are Critical)

Number (See Charts)	Symbol	Substance	Boiling Point at 1 Atm., Deg. C.	Highest Recorded Boiling Point, Deg. C.	Corresponding Vapor Pressure, Atm.
1	A	Argon	-185.8	-185.8	48
2	AsH ₃	Arsine	-54.8	15.6	13.2
3	BCl ₃	Boron chloride	12.5	80	5.6
4	BF ₃	Boron fluoride	-101	-52.2	11.54
5	Br	Bromine	58.8	89.4	2.82
6	BrH	Hydrobromic acid	-66.6	90	84.4
7	CO	Carbon monoxide	-190	-142.4	35.5
8	CO ₂	Carbon dioxide	-78.5	31	72.9
9	CO ₂ S	Carbon oxydisulphide	-50.2	105	61
10	CNCl	Cyanogen chloride	13.8	75	7.35
11	Cl ₂	Chlorine	-33.6	146	93.5
12	HF	Hydrofluoric acid	19.5	48	2.43
13	GeCl ₄	Germanium tetrachloride	84.5	277	38
14	H ₂	Hydrogen	-252.6	-252.6	12.8
15	He	Helium	-268.7	-268.7	22.6
16	Hg	Mercury	356.8	580	16.2
17	I ₂	Iodine	185.3	190	1.18
18	IH	Hydriodic acid	-35.4	150	80.8
19	Kr	Krypton	-152.9	-68.6	54.2
20	N ₂	Nitrogen	-195.7	-147	33.5
21	NH ₃	Ammonia	-33.35	132.8	112.3
22	NH ₂ NH ₂	Hydrazine	113.6	350	145
23	NH ₄ Cl	Ammonium chloride	337.8	520	34.5
24	NH ₄ HS	Ammonium sulphhydrate	32	44.4	2.05
25	N ₂ O	Nitrous oxide	-87.9	40	83.4
26	NO	Nitric oxide	-150	-98.9	64.6
27	N ₂ O ₄	Nitrogen peroxide	21.5	158.2	100
28	NOCl	Nitrosyl chloride	-5.5	40	5.1
29	Ne	Neon	-246.8	-228.3	27.1
30	O ₂	Oxygen	-183	-118.7	49.7
31	O ₃	Ozone	-110.5	-6	67
32	OH ₂	Water	100	374	207.6
33	PF ₃	Phosphorus trifluoride	-95	-10	40
34	PH ₃	Phosphine	-87.5	61.3	64.6
35	PH ₄ Cl	Phosphonium chloride	-26.8	80.1	75
36	PSF ₃	Phosphorus sulphofluoride	-53	20	12.8
37	Rn	Radon (niton)	-61.8	104.4	62.4
38	S	Sulphur	444.6	570	5.1
39	SH ₂	Hydrogen sulphide	-61.5	100	88.7
40	SO ₂	Sulphur dioxide	-10	150	71.5
41	SO ₃	Sulphur trioxide	44.5	318.3	83.8
42	SbI ₃	Antimony triiodide	400.6	445	2.35
43	SeH ₂	Selenium hydride	-42	138	58
44	SiF ₄	Silicon tetrafluoride	-86	-10	38
45	SiH ₄	Silicon hydride	-111.4	-3.4	48
46	SnCl ₄	Stannic chloride	114.1	318.7	37.9
47	Xe	Xenon	-109.1	16.6	58.2
48	Zn	Zinc	907	1,510	63

Vapor pressures of inorganic materials at pressures above 1 atm.

The chart below plots the vapor pressure curves for 38 of the substances listed in Table I on the preceding page, since it is off the chart. Curves for nine Helium, substance No. 15, is omitted more substances, including Nos. 2, 10, obscured and so appear on Fig. 2



Chemical Marketing Statistics Program of Bureau of Census

J. A. VAN SWEARINGEN

Economist, Bureau of the Census, Washington, D. C.

The Bureau's plans for the future in the way of collecting statistics on chemicals are presented by Mr. Van Swearingen. His particular reference to use of soda ash in glassware and the method used to determine costs in manufacture of sodium silicate will give some ideas to those engineers in marketing research.—Editors

IN MARKETING research, a truly beautiful and elaborate structure can be erected, but it must rest on a foundation of facts. Frequently such facts are hard to come by, as most researchers have found. This seems to be especially true in the chemical industry. In technology advancement has been rapid; statistically, medievalism prevails. The result is a considerable amount of guesswork, and the only possible answer is more and better facts. Without minimizing the importance of subjective considerations, which cannot be measured statistically, marketers and executives with planning responsibilities are insisting that these facts be obtained.

The need for such information is fully recognized by the Department of Commerce. Secretary Wallace, in his press statement of September 20 announcing his operating and organizational program for the department, stated that "the program calls for a vigorous expansion and strengthening of the department's facilities to enable it to discharge its statutory responsibilities during the period of reconversion and postwar adjustment." The expansion and strengthening of the department's facilities will include "a strong, balanced program of current and 'bench mark' statistics to provide adequate intelligence for business and government."

BUREAU'S PROGRAM

This part of the program is already taking shape, so far as it affects manufacturing industries. In broad terms, the bureau's program consists of a bench mark census of manufactures, supplemented by annual surveys in most fields, and abbreviated monthly and quarterly statistics for a number of industries which contribute importantly to the ebb and flow of the business tide. The

first bench mark census, which will probably cover the year 1946, will be along the same general lines as the biennial census conducted during the period 1919-1939. Intercensal statistics will be much more limited in scope than those obtained in census years, but for most areas it is planned to obtain some annual information on employment, wages paid and man hours, and a reasonable amount of information on individual products.

The program of monthly and quarterly statistics for the most part will be limited to the large and volatile industries. In moderate commodity detail, information will be obtained for production, shipments, inventories, new orders, or unfilled orders, or any combination of these measures which appears desirable and feasible. This program is already well under way, the results being published in the "Facts for Industry" series covering a wide variety of products in many major industrial areas.

USES AND LIMITATIONS

Census statistics for manufactures serve a variety of purposes, one of the most important being in marketing research. The perennial problem of the marketing research worker is "how big is my market and where is it?" In the past, the Census of Manufactures has provided at least partial answers to this problem. Production statistics have been available for a long list of commodities, particularly in the chemicals field, and a limited amount of information has been available on the distribution of products. It is true that the amount of detail was not adequate for some users, and that the production figures occasionally were in error. These represented serious limitations. For future operations, however, remedies appear to be at hand. Most important of all is the guidance being offered by industry people. Bureau contacts with industry are more numerous than ever before, which results in a much clearer picture of industry requirements. This is true with reference to both the amount of detailed product information required, and types of measures needed. In this connection, the Chemical Marketing Research Association has been particularly helpful. Second, reporting procedures have improved. With the numerous reporting requirements of the war agencies, manufacturers have acquired the know-how of reporting. Relatively simple report forms now being planned by the bureau should therefore

yield much more accurate statistics than heretofore.

While it appears likely that better production statistics will be available in the future, the picture is not so encouraging for information on the distribution of individual products. Here, reporting problems remain the stumbling block. For a large proportion of chemicals, the producer cannot report distribution information, since he does not know the ultimate destination of his products. This applies both to the geographic location of the buyer and the end uses of the material sold. Reporting by consumers is likewise fraught with difficulties, since frequently the consumer may identify his purchased material in terms other than those specified on the census report form. For example a census inquiry regarding the consumption of chlorine might be interpreted to include hypochlorite bleach. A second example has to do with the reporting basis. Consumers reporting their consumption of sulphuric acid for example, would be requested to report on a 100 percent H_2SO_4 basis. A particular consumer, however, might buy, and likewise report, on a 60 deg. basis. Errors of this type are extremely difficult to detect.

Reporting complexities thus preclude the collection and publication of consumption data for a wide variety of individual chemicals. For some chemicals, however, reporting by consumers appears to offer no great problem, and an attempt will be made to obtain consumption data for a number of items in the forthcoming Census of Manufactures.

Where a chemical is shipped directly to the consumer, distribution information supplied by the manufacturer is probably of maximum accuracy. Here, however, the reporting burden appears to be excessive for many industries, and accordingly, this procedure will not be followed in the Census of Manufactures.

It is well to bear in mind that practically all consumption statistics will be on an "industry" basis rather than in terms of "end products." This is because all consumption data will be on a plant basis, i.e., the reporting plant will report total plant consumption of a given item, with no reference to the product or process in which the item is used. Only in cases where a plant produces a single product, or where the consumption of a given material is clearly associated with a particular final product will it be possible to provide end-product information.

Enough for the anticipated improvements in basic data. Depending on the ingenuity of the research worker, the basic facts may be arranged to answer many special problems. "Arrangement" in this case refers to special tabulations. A "special tabulation" is simply a special way of sorting punched cards and adding up the basic facts. In publishing census results, cost factors limit the tabulations to general interest

tables, with the result that a great amount of information useful to a small number of people remains buried. A few examples will serve to illustrate the point. The 1939 Census of Manufactures indicated that the tableware and glassware industry consumed 87,922 short tons of soda ash in that year. The tableware and glassware industry, however, produces a variety of items, and the published data reveal nothing of the amount of soda ash that was consumed in the manufacture of lighting glassware. Possibly the answer can be found in a special tabulation. The procedure is simple. Lighting glassware produced in 1939 was valued at \$21,484,000. Of this amount, \$9,438,000, or 44 percent of the total, was made in plants which produced nothing but lighting glassware. By sorting and tabulating the punched cards for these plants, it is found that they consumed 5,490 short tons of soda ash, or about 582 tons of soda ash for each million dollars worth of glassware produced. It can be argued that 44 percent is a small sample, and further that it is biased because it represents the operations of specialized plants. Nevertheless, it is a small addition to the sum total of human knowledge, when used with discretion.

As another example, the researcher might wish to know labor costs in the production of sodium silicate. In the 1939 Census of Manufactures sodium silicate plants were classified in the "chemicals not elsewhere classified" industry, so that information regarding labor costs in the manufacture of sodium silicate was "buried" with that for other products. Following the procedure outlined above, however, it is a relatively simple matter to tabulate separately the labor data for those plants wholly or primarily engaged in the manufacture of sodium silicate. Further classification and tabulation of the same punched cards would reveal geographical differences in labor costs and differences relating to the size of the producing establishment. Tabulations such as these represent actual industry experience; the efficient and the inefficient operator, the modern and the obsolete operation are given equal weight in the computations. Therefore, the statistics are only indicative and they are not a substitute for more exact cost accounting procedures based on controlled conditions.

INDUSTRY'S PLACE IN PROGRAM

While the Bureau of the Census is ready to aid industry through the collection and publication of more adequate statistics and by rendering special services such as those outlined above, realization of ultimate objectives will depend in large measure on the assistance and cooperation rendered by industry. Individuals, companies, and trade groups are urged to make known their requirements. Preliminary drafts of many of the report forms are now available, and

more will be ready within the next few months. These forms are, or will be, available under the titles given below, and copies may be obtained from the Industry Division, Bureau of the Census, Washington 25, D. C. Members of the Chemical Marketing Research Association may obtain copies of the forms from Oliver Goddard, Naugatuck Chemical Division, U. S. Rubber Co., 1230 Sixth Ave., New York, N. Y., who is chairman of the association's statistics committee.

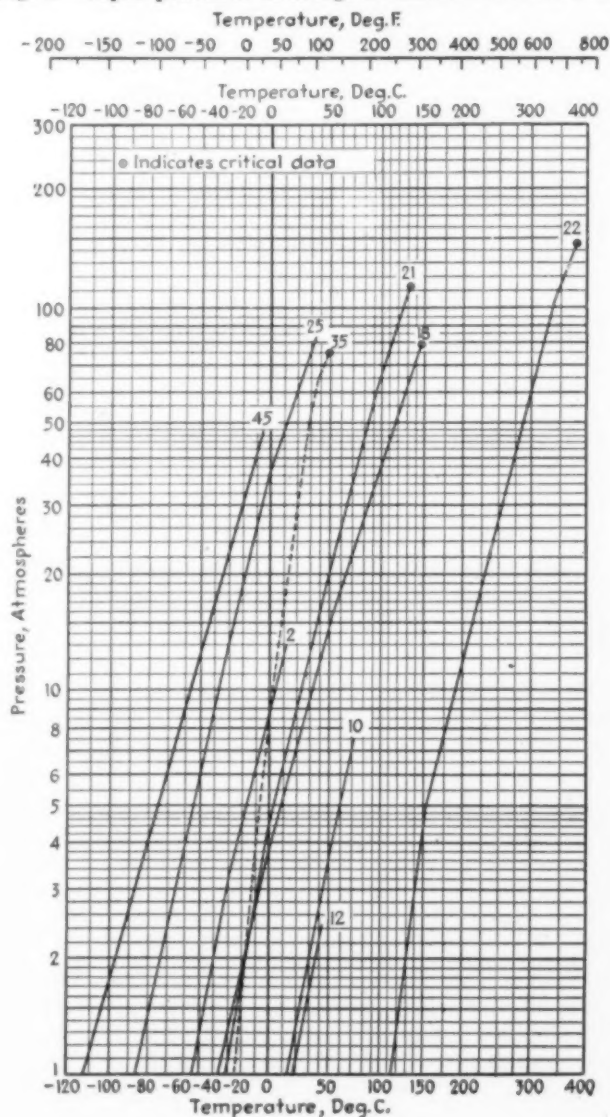
MC19A—Gum Naval Stores
MC19B—Bone Black
MC19C—Compressed Gases
MC19D—Tanning Materials
MC19E—Wood Distillation
MC19F—Chemicals

MC19J—Plastic Materials and Elastomers
MC19K—Synthetic Rubber
MC19L—Inks and Adhesives
MC19M—Rayon and Related Products
MC19P—Paints
MC19R—Ammunition
MC19S—Fertilizers
MC19T—Glue and Gelatin
MC65A—Drugs
MC66A—Soap and Glycerine
MC66B—Perfumes, Cosmetics and other Toilet Preparations
MC66C—Insecticides
MC79D—Plastic Products
MC74A—Rubber Manufactures
MC17A—Cottonseed Products
MC17B—Oils: Linseed, Essential, Fish and Miscellaneous.

VAPOR PRESSURES (Continued from page 130)

the central atoms. Tables II, III and IV reclassify the data according to temperature or pressure intervals to facilitate the comparison of substances.

Fig. 2—Vapor pressures of inorganic materials above 1 atm.



FROM THE VIEWPOINT OF THE EDITORS—

S. D. KIRKPATRICK, Editor • JAMES A. LEE, Managing Editor • THEODORE R. OLIVE, J. R. CALLAHAN, Associate Editors • HENRY M. BATTERS, Market Editor
L. B. POPE, RICHARD W. PORTER, JACK V. HIGHTOWER, EDMOND C. FETTER, Assistant Editors. • R. S. McBRIDE, Consulting Editor

BETTER TRAINING FOR FOREIGN SERVICE

CHEMICAL engineers know that the foreign service is wholly inadequate for at least one of the sort of technical problems frequently thrust upon it. That is the job of handling international relations which deal with industrial goods and technical services. Perhaps the professional men of the country can find a way in which to spotlight that inadequacy.

Even political and diplomatic relations become strained when trade and commerce difficulties arise. That fact should be clearly evident in the State Department. The remedy should also be obvious. Ideally, our diplomatic services, especially our consular officers, should be better prepared by being trained in matters of technology as well as foreign trade. They should know intimately the problems of strategic materials. They should know what goods the United States wants to get and what it wants to sell for the mutual benefit of this country and the foreign country where each officer is stationed.

It should not be beneath the dignity of even our ambassadors to deal with these vital trade matters. It should not be beyond their skill, or the skill of their technical staffs to deal with them. This would be a good time to consider a new policy schooling in industrial needs for all foreign service officials. They need that schooling quite as much as they need the essential training in diplomacy and international protocol.

PER DOLLAR OF SALES

CAN greater use of labor-saving devices and skill in handling of labor relations offset the burden of higher wage scales and union militancy? When this question was asked of an important consultant, his answer was that it depends both on the industry involved and the company within the industry. He cited a tabulation of industries arranged in order from the highest to the lowest as determined by labor cost as a percentage of the value of product. Coal and steel were at the top of the list with percentages of 50 or more. Automobiles ranked with other equipment industries, pulp and paper and rayon at 30 to 40 percent. Next came three process industries—chemicals, glass and rubber goods—at 25 to 30 percent. Petroleum production and refining at 20 to 25 percent and cement, distilled liquors, paint and soap fell in the lowest bracket of 20 percent or less.

What does this mean? Those industries with the higher percentages probably offer greater opportunities for advances in labor-saving methods and machinery as elements in cost reduction. On the other hand, it is also evident that industries and companies with lower labor costs will be under less pressure for price increases in order to protect their profit margins. It is significant, we think, that most of the chemical process industries fall within the lower brackets.

AN ATOMIC OATH

IN THE opinion of the editor of *Metal Progress*, scientists and engineers, as a group, represent "our present hope that civilization—humanity even—can withstand the atomic blast." He holds that if the politicians, diplomats and militarists cannot devise some means of free interchange of the truth about atomic energy, at least the technologists can proceed on their own. His plan is to have these men meet internationally and open their proceedings by swearing to a new Hippocratic oath, for which he proposes the following:

"As a trained scientist or engineer, I acknowledge my profound belief that the laws of Nature operate for all mankind, irrespective of nationality, creed or color, and I am therefore in duty bound to share my searches and discoveries in atomic energy freely with all others, by word of mouth, writings, publications, and visitations, and that this paramount duty to Mankind transcends any lesser loyalty whatever."

There is food for thought in this proposal. Every plan for international control of the atomic bomb must come to grips with the problem of persuading the various nations to surrender some measure of their national sovereignty to a new world government. Editor Thum believes that the first and easiest step in that direction would be for the scientists and engineers most intimately concerned with atomic energy to transfer some of their personal sovereignty to an allegiance to mankind in general.

Most of us agree that science is and must continue to be international and that the true measure of the value of the engineering profession lies in its service to the public good. Therefore, we need not wait for an international meeting to begin the practice of the basic principles of such an oath. Indoctrination could well be started in our engineering colleges and by proper education become a part of our daily lives.

INTERNATIONAL TRADE IN KNOW-HOW

"OUR markets will thrive if our customers are prosperous." There, summed up in one sentence, is the guiding thought which lies behind one international training program for young chemical engineers. Although it is the program of a beverage distiller, it is one which can be applied with profit to most of the chemical engineering industries, even though their products may not fall in the luxury class.

Prosperity in any country is based on an ever-increasing level of education which, of course, includes science and technology. Promising young chemical engineers in many countries have been brought to the United States by Joseph E. Seagram & Sons in the past three years. They have been given twelve months in production and management work in the company (about three-quarters of the time in production), and then they have returned to their native lands, with

no Seagram strings attached. Although some industrialization of primarily agricultural countries can be achieved rapidly through the fermentation industries, they have had sound training in chemical engineering technology that can be well applied in any other industry which the "graduates" may enter on their return.

While this program may sound altruistic or idealistic, or both, there are several reasons for endorsing it. Good will for the individual company and its product is built both at home and abroad. International good relations are helped by such personal contacts between nations. Industry has the money that is required and it has the knowledge for the task. An opportunity is afforded to our own chemical engineers to learn from foreign organizations when American boys go in exchange.

This international trade in know-how can bring about much that is good. But it must be long-range planning, with eventual good placed above the immediate gain to any company or country.

PUBLIC SERVICE PATENTS

WHEN a patent based on governmental research is assigned to a public official for administration it must be assumed that that official will act in good faith. One of our subscribers, whose identity we are not at liberty to reveal, informs us that in his opinion this has not always been the case. He has been told that in at least one instance negotiations for licensing one such patent broke down because the (then) head of the department involved refused to give a clear definition of conditions which would constitute ground for cancellation. We regret, as he does, any appearance of irregularity in official proceedings. If there are more such cases, they should be presented for review, either at high executive level or to competent members of Congress who may investigate them. The public need not stand indefinitely the inevitable consequences of improper administration.

But, meantime, industry should not be afraid of dealing with public officials in these patent matters. There have been numerous patents assigned to the Secretary of Agriculture which have apparently been administered fairly and to the satisfaction of licensees. There have been, so far as we can learn, no cases where cancellable licenses have been arbitrarily withdrawn in the manner referred to by our subscriber. We believe that public officials, even those who might wish to do otherwise, will be constrained by the necessity of fair dealing.

There are obvious disadvantages of patents dedicated to the public or administered for the public by public officials. Such patents do not provide adequate profit incentive for large expenditure for needed development work. But in justice to all, such patents must be licensed to all proper

applicants through non-exclusive and non-transferable licenses. It would be far more dangerous for the public to have exclusive license grants with infinite opportunity for preference or even irregular private dealings on the part of officials. So long as there are publicly owned or publicly controlled patents, we must put up with the obvious handicaps in order to avoid the even greater temptation for improper dealings.

RESOURCES "EXHAUSTED"?

RESERVES of our natural resources, especially those from which we get most important metals and minerals, are determined with great difficulty. The degree of exhaustion of such supplies depends in many cases as much on the technology for use of low grade supplies as it does on the amount of mineral left in the ground.

Chemical engineers recognize this situation with respect to most of the mineral products which they process. They will, therefore, greatly welcome a recognition of the principle in high official circles of Washington. We should all be delighted that not only the Bureau of Mines, where we should expect such recognition, but also the State Department, where we might not expect it, has lately emphasized the importance of new technology in determining problems of mineral supply.

An outstanding interpretation on this subject was given in an address by Elmer W. Pehrson of the U. S. Bureau of Mines who spoke effectively and constructively before a recent meeting of AIME. More surprising, but no less welcome, is an address by Charles P. Taft of the Department of State before a group of mining executives at Denver. On that occasion Mr. Taft summarized part of his philosophy of importance to chemical engineers very effectively in the following language:

"There are other important considerations affecting the future of the mining industry as well as national defense. Reserves of many of our strategic metals do not assure supply for more than two or three decades with present technology. It therefore behooves the industries of this country not only to intensify efforts to develop new resources at home but also to develop foreign sources of supply. It is the duty of the government to provide every assistance in both these fields."

Many users of metallic and non-metallic minerals must vigorously follow the policy of advancing our technology of utilization. We have had outstanding success from the petroleum industry, both in more effective production and in more efficient refining. As postwar plans are made there is limitless opportunity, and need of comparable effort, in many other fields. Some of these are much less conspicuous than for petroleum; but to the industries themselves many are no less important than the more talked about "strategic" minerals.

Volume 53—Chemical & Metallurgical Engineering—Number 1

Chemical & Metallurgical Engineering is the successor to *Metallurgical & Chemical Engineering*, which in turn was a consolidation of *Electrochemical & Metallurgical Industry* and *Iron & Steel Magazine*, effected in July, 1906.

The magazine was originally founded as *Electrochemical Industry*, in September, 1902, and was published monthly under the editorial direction of Dr. E. F. Roeber. It continued under that title until January, 1905, when it was changed to *Electrochemical & Metallurgical Industry*. In July, 1906, the consolidation was made with *Iron & Steel Magazine*, which had been founded eight

years previously by Dr. Albert Sauveur. In January, 1910, the title was changed to *Metallurgical & Chemical Engineering*, and semi-monthly publication was begun Sept. 1, 1915. On July 1, 1918, the present title was assumed and weekly publication was begun Oct. 1, 1919. Monthly publication was resumed in March, 1925. Dr. E. F. Roeber was editor of the paper from the time it was founded until his death Oct. 17, 1917. After a brief interim he was succeeded by H. C. Parmelee. Ten years later, Nov. 1, 1928, Mr. Parmelee assumed other responsibilities in the McGraw-Hill Publishing Company and

Sidney D. Kirkpatrick was named to be editor. The present editorial staff of the magazine comprises, in addition to Mr. Kirkpatrick: James A. Lee, managing editor; H. M. Batters, market editor; T. R. Olive and J. R. Callahan, associate editors; L. B. Pope, R. W. Porter and E. C. Fetter, assistant editors. Editorial representatives are: J. V. Hightower and R. S. McBride, Washington; E. S. Stateler, Chicago; and Earle Mauldin, Atlanta.

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CHEM. & MET. PLANT NOTEBOOK

THEODORE R. OLIVE, Associate Editor

\$50 VICTORY BOND FOR A GOOD IDEA!

Until further notice the editors of *Chem. & Met.* will award a \$50 Series E Bond each month to the author of the best short article received during the preceding month and accepted for publication in the "*Chem. & Met. Plant Notebook*." Articles will be judged during the month following receipt, and the award announced in the issue of that month. The judges will be the editors of *Chem. & Met.* Non-winning articles submitted for this contest may be published if acceptable, and if published will be paid for at space rates applying to this department. (Right is reserved, however, to make no award in months when no article received is of award status.)

Any reader of *Chem. & Met.*, other than

a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are criteria of the judging.

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address entries to Plant Notebook Editor, *Chem. & Met.*, 330 West 42nd St., New York 18, N. Y.

DECEMBER WINNER!

A \$50 Series E Savings Bond will be issued in the name of

LESTER H. PETERSON

Development Engineer
Schering Corp., Bloomfield, N. J.

For an article dealing with a simple "unplugging" for use on bottom outlet reaction kettles that has been judged the winner of our December contest.

This article will appear in our February issue. Watch for it!

November Contest Prize Winner

BUILDING A SLAGGING TYPE GAS PRODUCER FOR PILOT PLANT GAS SUPPLY

T. P. HIGNETT and E. L. STOUT

Tennessee Valley Authority
Wilson Dam, Ala.

USE of producer gas in pilot plant work is often desirable, but if conventional types of gas producer are considered, the cost of gas manufacture may be prohibitive. However, a small-scale slagging-type gas producer of simple and inexpensive design has been used successfully in the development laboratories of the Tennessee Valley Authority to supply producer gas for pilot plant operation.

This gas producer, which is similar in design to the small phosphate blast furnace operated by the Bureau of Chemistry and Soils, (see Hignett, T. P., and Royster, P. H., *Ind. Eng. Chem.*, 23, 84, 1931) is shown diagrammatically in Fig. 1. A photograph of the unit is reproduced in Fig. 2. The shell of the gas producer is

of welded steel construction except for the bottom, which is bolted to the upper section and can be removed for cleanout purposes. The sides and bottom are lined with

a $4\frac{1}{2}$ in. course of firebrick. The unit is 64 in. tall, has a hearth diameter of $13\frac{1}{4}$ in. (I.D.) at the tuyeres, a shaft diameter of 24 in. (I.D.), and a total capacity of 13.1 cu.ft. Charge is introduced into the producer through a gas seal at the top, air for combustion is blown into the fuel bed through two tuyeres located on opposite sides of the producer near the bottom, and the slag is removed through a notch at the bottom. Short lengths of standard 1-in. pipe are used for the tuyeres; each is equipped with a peep sight and with water cooling on the part that extends inside the producer shell. The top

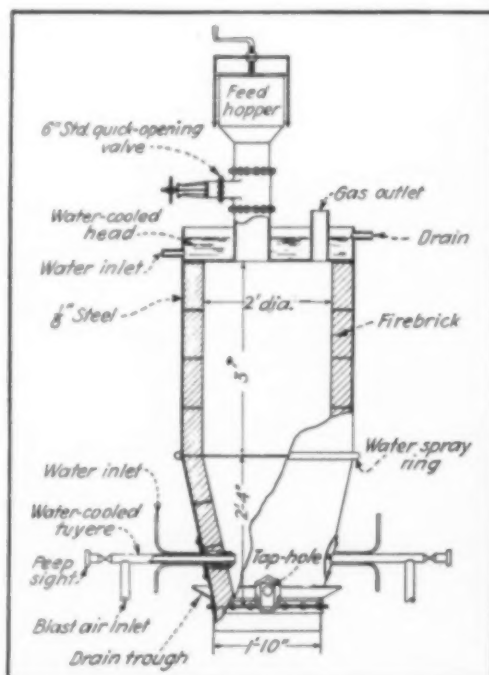
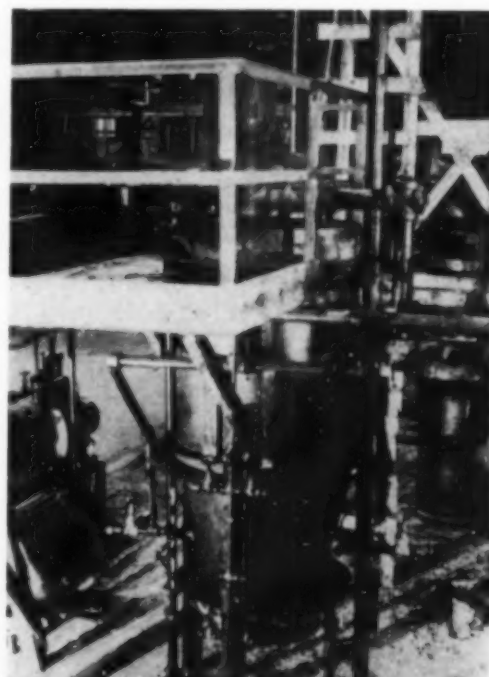


Fig. 1—Diagram showing how slagging type gas producer is constructed

Fig. 2—This small gas producer makes up to 8,700 cu. ft. of gas per hr.



of the producer is water cooled, and a spray ring is provided for cooling the lower part of the shell.

Manufacture of the gas is regulated by control of the blast-air rate, and any blower capable of supplying blast air at the desired rate and at a pressure of 3 lb. per sq.in.g.a. is satisfactory. A mixture of equal parts of plus 1/4-in. coke and iron blast-furnace slag is charged as necessary to maintain the stock level about 20 in. below the top. The purpose of the blast-furnace slag is to flux the coke and ash into a fluid slag which is tapped from the producer at intervals of from 30 min. to 1 hour, depending on blast rate.

Air rates of 3,900 to 7,200 cu.ft. per hour have been used to produce from 4,700 to 8,700 cu.ft. of gas per hour. In this range mechanical operation of the producer was very satisfactory, and the composition of the gas did not vary appreciably with changes in the blast rate. The analysis of the gas, on a dry basis, averaged: CO₂, 1.0 percent; O₂, 0.2 percent; and CO, 32.2 percent. Hydrogen, methane, and illuminants each averaged less than 1.0 percent. The dust content of the gas increased from about 0.3 to 0.5 lb. per 1,000 cu.ft. as the blast rate was increased from 3,900 to 7,200 cu.ft. per hour. Most of the dust was of particle size large enough to be removed in a cyclone dust collector.

Operation of this slagging gas producer was without the addition of steam to the blast air, since it was desired to make a gas that would approximate phosphate blast-furnace gas, which contains only a small amount of hydrogen. Should gas containing a higher percentage of hydrogen be desired, it probably would be necessary to use preheated blast air to increase the temperature of the combustion zone so that steam could be added. Otherwise, the admixture of steam in the blast to a small producer of this type probably would chill the combustion zone to such an extent that slag removal would be difficult.

AUTOMATIC ALARM FOR MANUAL VALVES

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THERE are still in operation processes in which several identical pieces of equipment are connected in parallel with manual valving. Such a system is shown schematically in Fig. 1, where valves (2), (3), (4), and (5) are manually operated directional control valves to permit flow through process unit A or process unit B, and valves (1) and (6) are manually operated block valves to isolate the entire unit. This diagram is typical of many systems, an example of which might be the process flow through two carbon adsorbers in a solvent recovery system. In such systems, it is usually highly desirable to have an indication on the control panel of the condition of the system at any time.

This is best obtained by mounting small switches, for example Micro Switches, on all the valve stems in such a way that the switch closes when the valve is opened. The switches are wired as shown in Fig. 2. In this manner, it will become immediately evident to the control operator by the lighting

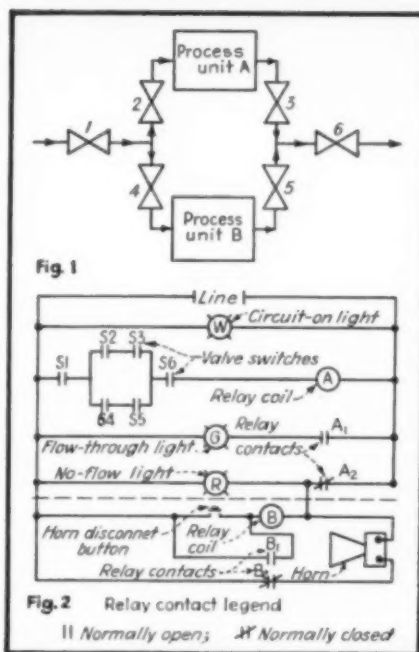


Fig. 1 — Parallel-mounted equipment with manual valving arrangement

Fig. 2 — Switch hookup should be identical with that of valves

of a red light and the sounding of a horn if some one inadvertently valves both units out of the circuit. If it is desired, the alarm circuit can be further elaborated upon to provide for emergency relief.

The important feature to be kept in mind, however, is that the switches should be mounted on all the valves and that they should be wired in a circuit which is identical with the piping. Therefore, a free flow path in the pipe circuit will be represented by a completed electrical circuit, which in fact, can then be used to actuate alarms or controllers.

USEFUL CONTROL VALVE FOR SOLIDS IN SUSPENSION

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IN THE continuous polymerization of synthetic rubber, the pressure on the system is maintained at a constant value by an automatically controlled discharge valve. The polymerized latex flowing through this valve is relatively unstable and readily coagulates when subjected to the rubbing action of a close clearance mechanism, such as encountered in an ordinary control valve. This phenomenon was encountered and created considerable trouble in the operation of a pilot plant unit discharging only 5 g.p.h. through a 1/2-in. line.

Accordingly, a 1/2-in., glass-lined Saunders Patent diaphragm valve was adapted for the service by preparation of only three new parts, a valve bonnet, an adapter and a pin, numbered (1), (2) and (3), respectively, in the sketch. The motor was taken in toto from a standard 1/2-in. three-way air valve with a 3-in. motor diaphragm. The valve bonnet

was drilled and threaded to fit the nut on the motor. The packing gland follower was used only as a base for the stem spring.

The rebuilt valve has operated with a pressure drop of 80 lb. across the valve for periods of time up to one month without cleaning. This may be compared to an average operational time of 8 hours between cleanings of ordinary control valves.

ACCIDENT PREVENTION WILL PAY OFF IN 1946

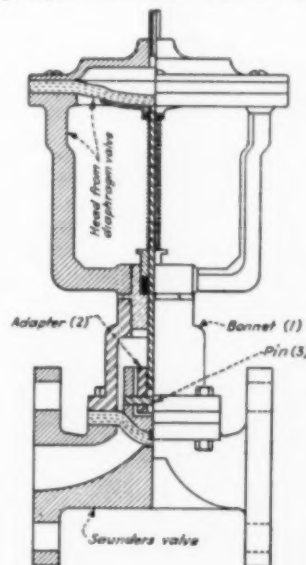
J. T. MORRIS
Superintendent
Pennsylvania Alcohol & Chemical Corp.
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WITH government policy calling for higher wages but with price ceilings held at present levels, greater productivity per man-hour will be required if prices and profits are to be maintained during 1946. This will test severely the ingenuity and abilities of safety management in that it points directly to increasing mechanization which in the chemical industry is attended by more than average hazard. Therefore, a review of safety engineering will be called for and a new approach necessary if we are even to preserve previous records.

Accident prevention is a responsibility of all levels of management, including managers, superintendents, department heads, and foremen. Its success rests primarily on foremen since theirs is the skill and personal contact necessary to knit patterns of safe handling into full production schedules. Statistics of insurance carriers show a relation existing between property size, as measured in number of employees, and the accident frequency rate, indicating that generally large plants have lower accident frequency than do small companies.

Our Safety Committee, meeting monthly, comprises department heads whose service averages better than 15 years. All security suggestions originating within the plant, ranging from minor correctives to those requiring major expenditure, are handled by this group. Each item in the weekly inspection

Diaphragm valve modified for slurries



tion report is investigated and assigned a number which is carried on both weekly and monthly reports until completion. As a result of continuity in this program, we have been awarded 11 certificates of merit in New Jersey's statewide interplant safety contests and have suffered no fatalities or fire losses for over 20 years.

Some safety innovations adopted since our last published resumé may interest readers who have hazards akin to our own.

BANISHING THE HAZARDS

One relates to the danger of measuring flammable tankage with calibrated steel rods because of friction sparks. K-Monel alloy rods, oxidized black can serve the purpose safely since their nickel and copper content prevents struck sparks at tank openings. Aluminum tank car dome covers with fill and suction pipes attached permit loading and unloading combustible liquids without danger of ignition from passing trains. A feature of this device is a telltale pennant float indicating at a distance liquid levels in the sealed car.

Chemical processing usually requires numerous tanks equipped with conventional gage glasses that are dangerous fire hazards when storing liquids of low flashpoint. To prevent spreading fire should a sight glass rupture, we installed automatic liquid level gages that pressure-seal their contents. Static electricity occurring around dissolvers or mixing apparatus always remains a problem. Especially difficult is its removal mechanically from belt drives. This situation can be well controlled by coating belt surfaces semi-annually with 25 percent colloidal graphite, suspended in carbon tetrachloride, thus making a conductive path through the line shaft to ground connections every 20 ft.

Another inexpensive suggestion adopted required purchasing hand trucks equipped with special Resinoid wheels for transferring nitrocellulose between our storehouse and production departments. These conductive wheels ground static charges built up on containers in handling, and dissipate them before unloading operations occur.

Obviously some recommendations were more than maintenance problems and called for major appropriations. One was for an automatic carbon dioxide fire prevention system. This installation, operating either manually or mechanically on a rapid temperature rise, blankets the contents of over a dozen mixers with solid carbon dioxide in a matter of seconds. Simultaneously, agitator drives and solvent feed pumps stop through electric relays that also sound an alarm. Further protection includes use of a scale for occasionally checking weight losses without removing the gas cylinders from the system, while a reserve set of cylinders remains connected at all times.

Though repair and replacement account for half the ideas received, this periodic preventative maintenance has had much to do with a record which currently averages better than 2,400 hours safe time per employee. Recommendations included changes in manufacturing methods, physical safeguards, general housekeeping, and the usual personal circumstances embracing them.

Often variations of manufacturing procedure present dangerous conditions even

though formulas are unchanged. For illustration, 1,000 gal. of viscous, low-flashpoint material will mix at 50 r.p.m. in one day with only a 10 deg. temperature rise, while identical components in a 100-gal. vessel can build up frictional heat sufficient to vaporize its contents within an hour despite equal agitation speeds. Another example relates to equipment substitution. An aluminum fractionating column was put in service refining amyl alcohol for a rush order. After several days operation had removed protective oxides, the apparatus became unmanagable and registered temperatures beyond normal. Upon shutting off the steam, recording instruments continued rising, due to an exothermic reaction that practically reduced the column to aluminum amylate, while only prompt action of employees prevented a disastrous fire. Butyl alcohol, in the presence of catalytic impurities, perhaps would have reacted the same way.

One hurdle safety men face eventually is approving necessary expense to adapt new installations to existing facilities against controlled budgets, knowing that hazards abound in even everyday manufacturing. Collective thinking within committee often produces satisfactory alternates, capable of saving both time and money without sacrificing principles. For example, high concentrations of toxic, flammable fumes settled around process control platforms during charging operations. Rather than to delay remedying the situation while waiting for explosion-proof fans and ducts, fresh air jets were installed in the floors, thereby dispersing these heavy vapors at little cost.

ACCIDENTS' HIDDEN COSTS

Accidents represent uninsurable, hidden costs that are estimated to be four times the amount expended for compensation and medical attention. Employers who believe their insurance companies pay all expenses when a mishap occurs fail to reckon with important incidentals, such as time losses of injured and fellow employees, supervisory investigations, production losses, idle or damaged equipment, training replacements, spoilage, etc.

Our safety work reflects itself best in the

basic compensation insurance rates applicable to our chemical manufacturing at Carlstadt, which averaged a modification credit of 27 percent for the past five years. Further evidence that industrial safeguards can accomplish tangible, worthwhile results is borne out by our declining fire insurance rates on buildings, machinery, and stock as published by the Schedule Rating Office of New Jersey. Starting nine years ago with a rate of \$7.25 per \$1,000, we have consistently reduced it to the present rate of \$3.07 per \$1,000 of value. This item alone amounts to a net saving in insurance cost approximating 57 percent.

Assuming the postwar era will provide an opportunity to escape many bans and restrictions, it also projects new obligations for both human and material security. With this thought in mind we wish a continuance of the genuine help and guidance afforded by our parent organization, The National Sugar Refining Co., whose safety personnel candidly strives for future betterment.

SIMPLE FLOWMETER FOR LIQUIDS OR GASES

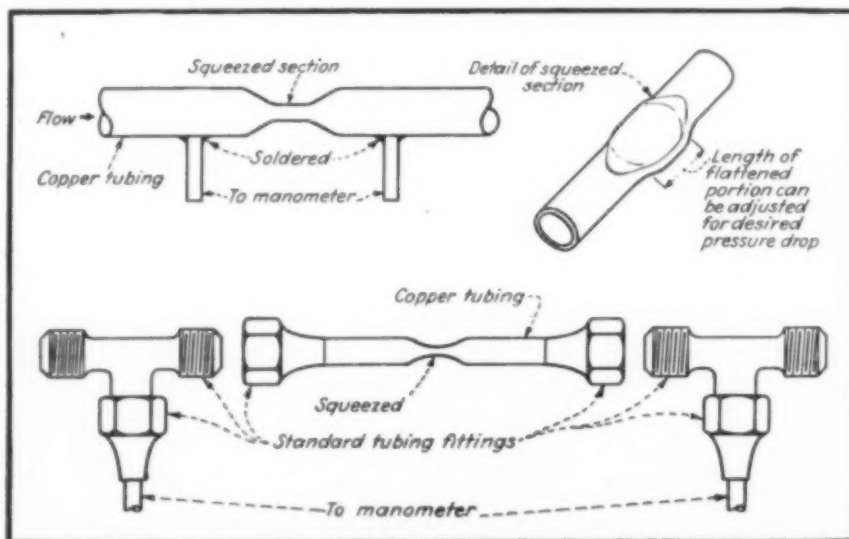
LESLIE SILVERMAN

Department of Industrial Hygiene
Harvard School of Public Health
Boston, Mass.

A simple flowmeter for metering gases or liquids can be constructed from copper tubing as shown in the accompanying sketch. No orifices or special fittings are necessary. Standard tubing and fittings are used throughout. Two taps are soldered into the tubing wall, or the manometer can be connected to tubing tees as shown. The flowmeter orifice section is made by squeezing the tubing in a vise or between a C-clamp. The advantages of this meter are its simple construction and its similarity in pressure loss characteristics to a venturi section. A further important advantage is that it can be adjusted to any desired manometer reading while installed by squeezing with a clamp or vise. For high pressures it is advisable to leave the clamp in place if thin-wall tubing is used.

Calibration is performed by volumetric collection or by means of standard meters.

Differential pressure flowmeter made by squeezing copper tubing





REPORT ON.....

CHEMICAL REQUIREMENTS

Of the Petroleum Refining Industry

The petroleum refining industry has received considerable attention not only because of its spectacular achievements during the war but for its increasing importance as a producer of synthetic organic chemicals as well. Not so well known, perhaps, is the fact that this industry each year consumes large quantities of a wide variety of chemicals for use in the manufacture of its many products. Modern refining has become far more than a simple matter of distillation and cracking. New types of products being manufactured, new processes, and increasing amounts of crude processed are among the reasons why a large tonnage of these chemicals enter refinery gates. This report highlights the principal chemicals involved, discusses their more important functions and considers some factors pointing to heavier future consumption.

THE DEMAND in the petroleum refining industry for chemicals and allied products is increasing in magnitude and variety. Principal reasons for this are (1) The increasing amount of crude processed, (2) the war-accelerated development of new catalytic processes adapted to the manufacture of new or improved products, (3) recovery and utilization of hydrocarbon gases formerly burned as fuel, (4) the resort to "marginal" crudes which require heavier chemical treatment of their products, (5) growing application of additives to improve the performance of gasolines and lubricants, (6) exchange of information among refiners during the war, which has led to wide adoption of processes requiring chemicals.

Petroleum refining is no longer a matter of crude distillation, thermal cracking and treating with sulphuric acid and caustic. More chemicals from petroleum, more pure hydrocarbons, more "tailor-made" products, are being manufactured. Research and development is absorbing an increasing percentage of company appropriations. Refiners are gaining technological mastery over petroleum and in the process are consuming

a greater variety of chemicals than ever before.

Refining may be divided broadly into four phases with respect to the principal uses of chemicals. These phases are (1) Treatment and distillation of crude and subsequent fractionation of its products, (2) alteration of the molecular structure of products of fractionation, (3) use of chemicals and allied materials to blend with or to treat the products of phases (1) and (2) for improvement of quality or protection of equipment, (4) chemical conditioning of tremendous quantities of water required for condensing, cooling and steam.

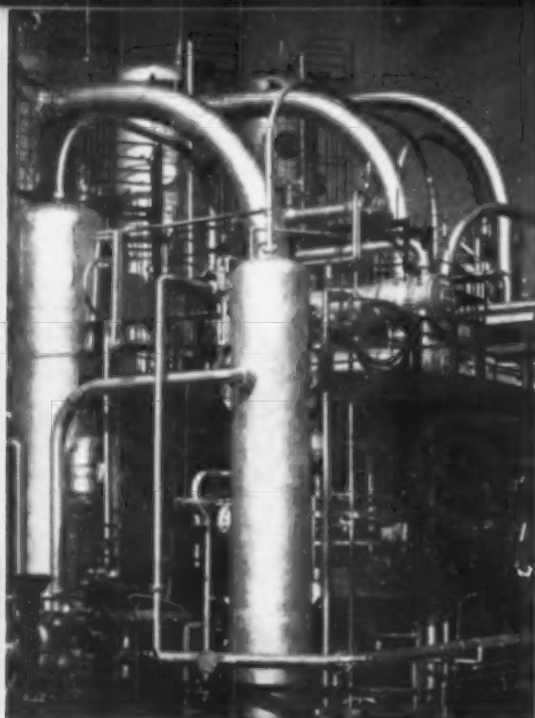
CONSUMPTION SURVEY

In 1942 the Petroleum Administration for War surveyed the chemical requirements of the refining industry. The survey covered the 12-month period ending October, 1941, and the results, therefore, indicate the normal consumption of chemicals immediately preceding the war. Table I shows the principal chemicals used. Leading the list is sulphuric acid. Widely used in prewar years for treating gasolines, distillates and

lubricating oils, this acid enjoyed an accelerated demand during the war from the sulphuric acid alkylation process. The total sulphuric acid consumption during the period covered was actually higher than the figure shown, as refiners manufacturing their own acid reported a consumption of 70,900,000 lb. of sulphur, the major portion of which went into the production of acid.

Next to sulphuric acid in volume of requirement is clay. Prior to Pearl Harbor, clay, either as it came from the beds or after acid treatment, was used principally for the filtration of lubricating oils and fuel oils and to a lesser degree in the catalytic cracking of gas oils. A certain amount was used in the treatment of cracked gasolines. During the war the use of treated clay expanded because of its utilization as a cracking catalyst in the manufacture of base stock for aviation gasoline.

Sodium hydroxide, third in the list, is, like sulphuric acid, a "work horse" in petroleum refining. It has been and continues to be used throughout the industry for the neutralization of acid treated products, removal of sulphur compounds from gaseous



Solvent recovery system used in the process for manufacturing lubricants by extraction with phenol and cresylic acid by the Shell Oil Co. at its Wood River, Ill., refinery

and liquid hydrocarbons, treatment of water and many other services.

The fourth largest requirement shown in Table I is for tetraethyl lead fluid. Used as an anti-knock additive in motor and aviation gasolines, this material bulks large because of the great volume (700,000,000 bbl. in 1941) of gasolines manufactured.

After Pearl Harbor, the needs for some chemicals, relative to their previous use, expanded considerably. The main expansion occurred, of course, among chemicals utilized in production of aviation gasoline or its components. Table II shows the estimated consumption of chemicals required in eight refineries of major companies in 1944. The consumption figures are weighted in accordance with the average daily crude throughput of each plant, the average for the group being about 45,000 bbl. per day. These plants were either manufacturing components for 100 octane aviation gasoline or were making the finished product. The plants reported no consumption of solvents except cresylic acid, commonly used for solvent dewaxing and extraction of lubricants, indicating that their lubricants were produced by other processes. On the basis of one barrel of crude charged, the requirements of the eight refineries showed a marked increase over the average consumption for the entire country in 1941, with respect to the following leading chemicals: hydrofluoric acid, sulphuric acid, bauxite, aluminum chloride and tetraethyl lead fluid.

Typical wartime chemicals include hydrofluoric acid, which had no significant place in refining prior to 1942 but which has become a major chemical used in the hydrofluoric acid alkylation process for the manufacture of alkylate, a high-octane com-

ponent for gasoline. Bauxite, another material relatively little used before the war, is also used in the alkylation process. Aluminum chloride, which formerly had rather restricted uses, jumped into national importance in the war as the catalyst for isomerization, principally in the conversion of normal butane to isobutane, one of the raw materials for alkylation. Sulphuric acid was consumed in greater amounts by reason of the construction of alkylation plants utilizing the sulphuric acid process. Consumption of tetraethyl lead rose during the war because of its use, averaging over 4.0 c.c. per gal., in aviation gasoline and in smaller quantities in other military gasolines.

CHEMICAL PROCESSING

With reference to the arbitrarily designated four phases of refining in which chemicals are employed, the first—distillation of crude and subsequent fractionation of straight-run products—utilizes appreciable amounts of ammonia and caustic soda in those instances where crudes containing significant percentages of magnesium chloride and hydrogen sulphide are processed. Refiners vary in their application of these chemicals and encounter different results depending on the precise nature of the impurities in the crude and the operating conditions in the equipment in which the chemicals are applied.

An Illinois refinery for instance has a 35,000 bbl. per day crude distillation unit processing West Texas crude of 1.5 percent sulphur content and containing 11 lb. of salts per 1,000 bbl. The naphthas from this unit are scrubbed with caustic soda solution for removal of hydrogen sulphide. Anhydrous ammonia is injected into the vapor lines from three naphtha fractionators to minimize corrosion in condensers.

Caustic and ammonia requirements per bbl. of crude charged have been, respectively, 0.2 lb. and 0.04 lb.

Alteration of the molecular structure of the intermediate products of refining involves a number of processes requiring chemicals and allied products. Foremost among these processes are thermal and catalytic cracking, alkylation, catalytic polymerization, butane isomerization and the manufacture of butadiene. Catalysts, the principal chemicals consumed, are regenerated, but losses of catalyst ultimately occur by physical loss from the equipment and systematic rejection of catalyst when regeneration is no longer profitable.

Thermal cracking obviously does not require a catalyst. However, when the oils being cracked contain much corrosive material, such as hydrogen sulphide, other sulphur compounds or unstable chlorides, chemicals to nullify the effects of these trouble makers are frequently used. Corrosion of equipment cost refiners many millions of dollars yearly, and has been the subject of numerous investigations by chemists and engineers. The cracking of oils of high sulphur content, such as gas oils and residuals from West Texas and New Mexico crudes, is generally performed with the aid of neutralizing chemicals to protect equipment which is not sufficiently corrosion-resistant. A common agent is lime. The usual practice is to inject lime in the form of an oil slurry into the discharge side of the cracking coil charge pump. In the cracking of Midcontinent heavy gas oils and residual lime has been used to the extent of 0.1 to 0.2 lb. per bbl. of fresh charge. A major oil company found it necessary, when cracking a West Texas residual stock, to use between 0.4 and 0.5 lb. of lime per bbl. charged to the cracking unit. In that instance the lime consumption amounted to

Large quantities of sulphuric acid, aluminum trihydrate and sodium silicate solution are used by Socony-Vacuum Oil Co., Inc., Paulsboro, N. J., in this 50 ton per day synthetic bead catalyst plant



Table I—Principal Prewar Chemical Requirements of the Refining Industry

Chemicals Consumed — 12-Month Consumption Ending October 1, 1941 (Pounds)

Acetone	1,829,000	Inhibitors, misc., oil	2,400,000
Acetylene	552,000	Lead naphthenate	101,500
Acid, acetic	2,912,000	Lead oxide	12,400,000
Acid, fatty, mixed sources	1,400,000	Lithopone	660,700
Acid, oleic	523,000	Methylethyl ketone	1,185,000
Acid, stearic	2,360,000	Methyl dichlorostearate	411,400
Acid, hydrochloric	1,780,000	Nitrobenzene	1,086,000
Acid, isobutyric	85,000	Oil, castor	118,000
Acid, phenyl stearic	92,000	Oil, coconut	207,500
Acid, phosphoric	1,300,000	Oil, corn	412,000
Acid, sulphuric (100%)	907,000,000	Oil, cottonseed	200,500
Alcohol, ethyl	700,000	Oil, fish	227,000
Alcohol, isopropyl	300,000	Oil, lard	5,560,000
Alpha naphthal	134,000	Oil, pine	670,000
Aluminum chloride	92,000	Oil, rapeseed	2,900,000
Aluminum oxide	8,400,000	Oil, rosin	525,000
Aluminum stearate	555,000	Oil, soybean	133,000
Aluminum sulphate	3,900,000	Oil, sperm	1,420,000
Ammonia, anhydrous	4,856,000	Oil, tallow	18,200,000
Ammonia, aqua	6,800,000	Oxygen	2,310,000
Asbestos	424,000	Phenol	4,137,000
Barium hydroxide	313,900	Phenol, tertiary amyl	234,000
Bauxite	10,000,000	Pine tar	248,000
Benzene	3,720,000	Potassium hydroxide	1,064,000
Calcium carbide	3,227,000	Potassium nitrate	785,000
Calcium carbonate	214,000	Potassium phosphate	101,000
Calcium chloride	5,113,000	Pyrethrum	2,553,000
Calcium hypochlorite	244,000	Rosin	925,000
Calcium oxide & hydroxide	51,000,000	Sodium aluminate	934,000
Calcium sulphate	398,000	Sodium bicarbonate	405,000
Carbon dioxide	1,147,000	Sodium carbonate	28,444,000
Carbon disulphide	463,400	Sodium chloride	33,770,000
Carbon tetrachloride	1,240,000	Sodium dichromate	231,400
Chlorine	3,300,000	Sodium hydroxide	211,200,000
Chloroform	126,900	Sodium metaphosphate	644,000
Chloronaphthalene	304,000	Sodium nitrate	676,000
Clay	274,000,000	Sodium phosphates	2,225,100
Copper chloride	260,000	Sodium silicate	496,000
Copper oxide	246,000	Sodium sulphate	3,820,000
Copper sulphate	948,000	Sodium sulphide	1,486,000
Cresol	3,400,000	Sodium sulphite	189,800
Dichloroethyl ether	404,000	Sodium sulphonate	700,000
Dibutyl phthalate	586,000	Sulphur	70,900,000
Diethylene glycol	247,000	Sulphur dichloride	2,048,000
Dyes, misc.	396,000	Sulphur dioxide	3,879,000
Ethyl acetate	600,000	Sulphur monochloride	135,000
Ethylene dichloride	1,984,000	Talc	2,200,000
Fats, animal	2,200,000	Tetraethyl lead fluid	77,000,000
Ferric sulphate	167,000	Toluene	1,600,000
Ferrous sulphate	659,000	Tricresyl phosphate	696,200
Formaldehyde	71,000	Turpentine	8,100,000
Furfural	2,400,000	Water treating agents, misc.	1,183,000
Glycerin	80,000	Wax, montan	450,000
Graphite	793,000	Wool grease	1,394,000
Inhibitors, misc., gasoline	2,400,000		

between 6,000 and 7,500 lb. per day. Some refiners have also refluxed their cracking unit evaporators with lime-bearing bubble tower bottoms.

In catalytic cracking the consumption of catalyst (basically, silica-alumina) is found to vary considerably in commercial practice. Regeneration of spent catalyst by periodic oxidation is, of course, the rule in the Fluid, Houdry and Thermoform processes, but, in time, the catalyst reaches the point where continued regeneration does not pay. In addition some catalyst is lost mechanically from the cracking units through mishaps of operation, attrition of catalyst and starting and ending periods of operation. Without regard to types of process involved, each of which has shown a rather wide range of catalyst consumption under different circumstances, catalyst requirements have varied roughly between 0.1 and 0.5 lb. per bbl. of charge to the reactor. In terms of a unit charging 15,000 bbl. per day of gas oil, these figures are equivalent to catalyst consumptions ranging from 1,500 to 7,500 lb. per day. The total manufacturing capacity for synthetic cracking catalyst in the United States is reported as approximately 200 tons daily.

Hydroforming, the process used during the war in petroleum refining to manufacture synthetic toluene, utilizes a dehydrogenating oxide type of catalyst in fixed beds which are periodically regenerated by burning off the deposited carbonaceous matter. Catalyst consumption is reported to be in

the vicinity of 0.2 to 0.4 lb. per bbl. of naphtha charged to the hydroforming unit. Much the same general considerations affecting the consumption rates for catalytic cracking apply to hydroforming.

ACID ALKYLATION

The two alkylation processes of present commercial importance are those utilizing hydrofluoric or sulphuric acid as the catalyst. In the alkylation procedure isobutane is combined with one or more of several olefins, notably butylene, to form a high-octane motor fuel. The hydrofluoric acid process brings the isoparaffin and the olefins into contact in the presence of liquid anhydrous hydrofluoric acid, which is subsequently recovered by distillation and used again in the reactor. During the war the consumption of this acid was reported as ranging around 1.5 lb. of acid per bbl. of alkylate manufactured by the process. Much of this was in the form of physical loss by leakage from equipment, although the formation of organic fluorides inevitably accounted for a small part of the loss. Operation of alkylation units under severe conditions to expand production, and the use of unsatisfactory feed stocks for the same purpose, were additional factors. Production of alkylate by the hydrofluoric acid process reached about 60,000 bbl. per day early in 1945. Subsequent improvements in alkylation equipment have been made, reducing acid leakage. A large oil company

declared a short time ago that it was manufacturing alkylate at a hydrofluoric acid consumption of only 0.7 to 1.0 lb. per bbl. of alkylate. In addition to the acid, hydrofluoric acid alkylation units utilize bauxite, or alumina in some instances, both for drying the feed gases and for removing traces of organic fluorides from vapor streams after the reaction. This was the major use of bauxite in petroleum refining during the war.

The sulphuric acid alkylation process uses an acid of 96 to 98 percent initial strength. The acid, through sustained contact with the inflowing isobutane and olefin feed gases, gradually declines in strength and is generally regarded as spent when an acidity of about 90 percent is reached. Acid consumption is governed by various factors such as reaction temperature, character of the feed gases and other operating variables. The range of consumption when butylenes dominate in the olefin gases has been from 1.0 to 2.0 lb. of fresh acid per gal. of alkylate, or between 42 and 84 lb. per bbl. In addition to acid, caustic solution is ordinarily used to scrub the feed gases for removal of mercaptans and other objectionable impurities.

It hardly need be pointed out that the "spent" acid, rejected at a strength regarded as desirable for optimum operation, can be used for other purposes than alkylation. In the last few years a number of refiners selected the sulphuric acid alkylation process partly because they could use the spent acid for treating gasoline, kerosene and lubric-

Table II—Wartime Chemical Consumption of Eight Refineries

(Average Daily Crude Throughput, All Refineries, 45,000 Bbl.)

Chemicals Consumed—Estimated Consumption, 1944 (Pounds)

Acid, hydrochloric	419,100	Dyes, misc.	71,100
Acid, hydrofluoric (anhydrous)	342,800	Ferric sulphate	1,700
Acid, isobutyric	10,900	Inhibitors, misc.	100,100
Acid, phosphoric	39,300	Litharge	143,000
Acid, sulphuric (100%)	78,505,400	Methanol	96,000
Aluminum chloride	248,300	Phenol	148,800
Aluminum, sulphate	40,300	Potassium hydroxide	71,500
Ammonia (anhydrous)	1,425,600	Potassium isobutyrate	16,000
Antimony trichloride	53,000	Potassium phosphate	18,000
Arsenic trioxide	1,000	Quachrom glucosate	58,600
Bauxite	795,000	Sodium aluminate	6,500
Calcium chloride	51,800	Sodium bicarbonate	25,600
Calcium hydroxide	1,156,000	Sodium carbonate	861,900
Calcium hypochlorite	1,000	Sodium chloride	110,200
Calcium oxide	1,718,000	Sodium hydroxide	11,806,500
Calcium sulphate	133,300	Sodium phosphate	184,000
Clay	10,808,200	Sodium sulphate	1,600
Carbon dioxide	18,200	Sodium sulphide	19,100
Catalyst, synthetic silica-alumina	1,365,000	Sodium sulphite	14,800
Catalyst, misc.	436,900	Sulphur	538,800
Chlorine	170,800	Sulphur dioxide	43,700
Copper sulphate	27,500	Tetraethyl lead fluid	5,100,000
Creosols, cresylic acid	91,000	Zinc oxide	5,000

ants. In some instances the rejected acid is immediately reconcentrated and again used for alkylation.

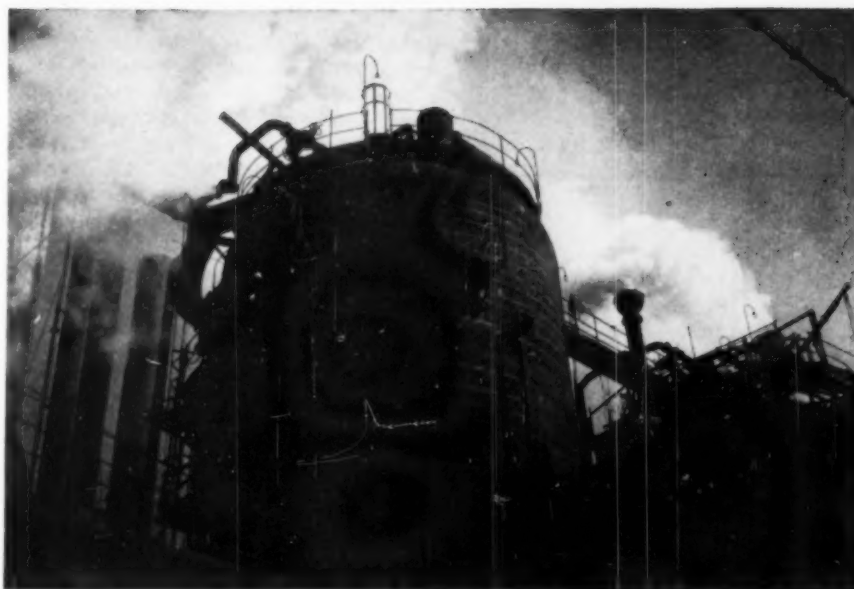
Catalytic polymerization, one of the mainstays in the manufacture of 100 octane aviation gasoline, combines refinery butylenes to make an iso-octane material which is then hydrogenated to iso-octane. When employed to produce a blending agent for motor gasoline the process commonly utilizes propylene as well as butylenes to secure a greater yield of products, which is not ordinarily hydrogenated. In the past, most catalytic polymer has been manufactured by the use of phosphoric acid as catalyst. The acid, supported on a siliceous mass, is regenerated a number of times before final rejection. The nature of the gaseous feed stocks and the processing conditions that prevail influence the life of the catalyst, which has been seen to vary considerably. However, a company having long experience with the process has encountered ultimate catalyst consumption rates of between 0.3 and 0.4 lb. per bbl. of polymer produced. These rates were observed in polymerizing mixed butylenes.

The isomerization of normal butane was practiced on a large scale during the war years for the purpose of furnishing isobutane needed in the manufacture of alkylate. Isomerization was performed with the use of aluminum chloride (promoted by a small amount of hydrogen chloride) as catalyst. Early in 1945 butane was being isomerized at the over-all rate of about 35,000 bbl. of isobutane per day. The conversion was accomplished at an aluminum chloride consumption rate of approximately 0.4 lb. per bbl. of isobutane, although rates vary.

Principal chemicals required in the manufacture of butadiene from petroleum are the catalysts and the solvents, notably ammoniacal cuprous acetate, for separating the butadiene product from other gases. Such chemicals are used whether or not the raw charge stock is butane or butylene. The catalysts belong, of course, to the group of oxides of metals such as chromium or molybdenum, capable of dehydrogenating hydrocarbons. Catalyst consumption in the Standard Oil Co. (New Jersey) butylene dehydrogenation process has ranged from 0.06 to 0.17 lb. of catalyst per gal. of butadiene.

IMPROVING PRODUCTS

The third phase of refining operations, using chemicals to remove undesirable materials from refinery products and to impart special performance characteristics to those products, is featured by the use of many different chemicals and can be but briefly summarized. The removal of objectionable materials by chemical treatment is one of the major aspects of refining. An example is the treatment of gasolines, particularly those manufactured by cracking processes or those which contain high percentages of sulphur or its compounds. As a general rule gasolines are treated to remove or render



Crushed lime and soda ash are used in this 100,000 gal. per hr. Cochrane feed-water treating unit for high pressure boilers at Shell's Wood River plant

innocuous sulphur compounds, gum-forming constituents and, to a decreasing extent, color-forming agents. Some straight-run gasolines are lightly treated if they contain objectionable quantities of sulphur materials. Components in gasolines which cause discoloration, more of an eye-sore than an index of inferiority, are not the problem they used to be because the general use of dyes is the inexpensive answer to that difficulty. When it is considered that gasolines are being turned out at the rate of some 2 million bbl. per day, of which over half is cracked material, the magnitude of the treating involved can be grasped. Roughly 40 percent of the crude processed in the United States is converted into gasoline.

Until the accelerated use of other treating agents and additives developed in recent years, sulphuric acid was the universally employed chemical for gasoline treating. It is still widely used in refining. The amount of acid required per barrel of gasoline for reduction of sulphur and gum-forming constituents varies greatly, depending on the nature of the raw gasoline, strength of acid and the degree of refining desired. Much straight-run gasoline is not acid treated at all, although frequently given a small caustic wash. On the other hand acid treatments of from 1.0 to over 10.0 lb. per bbl. are necessary with cracked gasolines or those containing a high percentage of sulphur compounds. A common practice is to utilize sulphuric acid from gasoline treating for the treatment of heavier oils. Acid treatment regularly calls for the neutralization of acid traces by scrubbing the product with caustic solution. Although no statistics on the total quantity of caustic consumed for this purpose are available, the amount is undoubtedly large because of the great volume of cracked gasoline manufactured daily. The regular practice is to discard the spent

caustic. Refinery records indicate a caustic consumption of 0.2 to about 1.0 lb. per bbl. of gasoline treated.

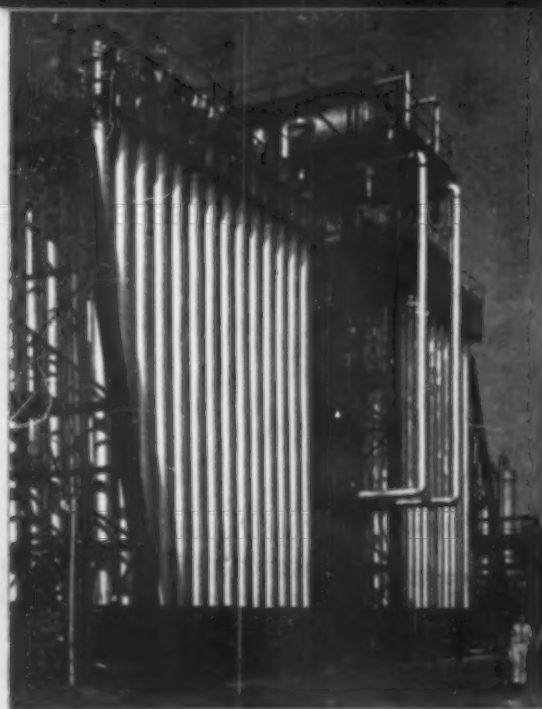
The use of sulphuric acid has been supplemented to some degree by the contacting of gasoline vapors with clays or bauxite, a process which can be employed to convert sulphur compounds to hydrogen sulphide (subsequently removed without difficulty) and to remove gum-forming diolefins. Clay life ranges between 2,000 and 4,500 bbl. of gasoline per ton of clay. The clay may or may not be regenerated.

SWEETENING

Doctor sweetening of gasoline to convert smelly mercaptans into less objectionable disulphides is another old treating process that is still in much use. The gasoline is agitated with a solution of sodium plumbite formed by dissolving litharge in caustic solution. This process accounts for the heavy demand for litharge in the refining industry, although the doctor solution can be regenerated by air blowing. Refiners have reported litharge consumption from 0.1 to 0.5 lb. per bbl. of gasoline treated.

Other well known chemicals used for the removal of sulphur compounds or for changing them into tolerable forms are caustic in water solution, caustic solution containing various other agents such as methanol, potassium isobutyrate and certain organic salts, caustic-tannin solutions, sodium hypochlorite and cupric chloride. Consumption of these chemicals depends on the nature of the gasoline, the quality of product desired and the costs of regeneration.

In the field of additives, used to impart to petroleum products special performance characteristics, an increasingly large amount of chemicals is used annually. Additives used in unsaturated gasolines to avert forma-



Reaction tubes of the Shell Oil Co.'s 800 bbl. per day polymerization unit which uses phosphoric acid catalyst

tion of gums through oxidation are replacing sulphuric acid to an appreciable degree. They were reported consumed to the extent of 2,500,000 lb. in 1941. One refiner has used gum inhibitors to the extent of from 3 to 10 lb. per 1,000 bbl. of gasoline, although the consumption in a specific instance depends on the nature of the inhibitor and character of the gasoline treated. Gum inhibitors, some of them undisclosed, include such products as alpha naphthol, substituted catechols, cresols, benzol- and butyl-amino-phenols, phenylenediamines and some wood tar and coal tar fractions. Additives have come into competition with sulphuric acid because of the frequently high polymer and solution losses encountered in acid treatment of certain types of gasoline.

ETHYL FLUID

The use of ethyl fluid (tetraethyl lead) to increase the octane number of gasoline hardly needs comment. In the PAW survey the consumption of this product was reported as 77,000,000 lb. Production rose sharply during the war, as the restricted use in civilian gasolines was more than compensated by heavy military requirements. Ethyl fluid is used in motor gasolines in quantities ranging all the way from none at all to 3.0 c.c. per gal., the amount depending on the initial octane number and characteristics of the gasoline, and in aviation gasoline the concentration may run up to 4.6 c.c. per gal.

Kerosene and range oil, amounting to 5 percent of total crude processed in the United States, are as a rule treated to remove sulphur compounds, coloring matter and, in some instances, aromatics. Agitation with sulphuric acid followed by water washing and neutralization of acid traces by

means of caustic solution is a standard practice. As in the case of gasoline the acid requirements vary with the nature of these distillate fuels, but the range is usually from 1 to 10 lb. per bbl. of distillate treated. Generally, from 1 to 3 lb. of caustic soda is used in neutralization. Doctor sweetening may also be applied to kerosene and range oils. As in the case of sweetening gasolines by this method, a small amount of elemental sulphur is added to precipitate the lead as lead sulphide. Agitation of distillates with liquid sulphur dioxide is often employed for the extraction of excessive percentages of aromatics and for removal of sulphur. The solvent is recovered and losses are slight.

Diesel oils are also subject to chemical treatment. Requiring a low percentage of aromatics if they are to function to best advantage in engines, they may be treated with liquid sulphur dioxide, which by extraction of the aromatics, materially improves performance. Additives may be employed for the same purpose. Alkyl nitrites and nitrates have been used for this purpose.

Lubricating oils, like gasoline, ordinarily receive chemical treatment or are subjected to treatment with chemical solvents. Petroleum fractions containing lubricants are variable mixtures of paraffin, naphthenic, aromatic and asphaltic hydrocarbons as well as derivatives and related materials. Separation of the hydrocarbons is performed by one means or another in order to produce a finished lubricant having a composition suited to a particular service. Treatment with sulphuric acid and contacting with clay have long been practiced and continued to be used to improve color, odor and stability. About 15 years ago the use of solvent extraction for manufacturing preferred lubricants, and the addition of chemicals to lubricants to impart special qualities, began to spread. Solvents which have been used either alone or in combination include acetone, benzol, cresylic acid, sulphur dioxide, ethylene dichloride, dichloroethyl ether, furfural, nitrobenzene, phenol and propane. Losses of solvents are small and are confined to physical losses from equipment and slight solution in the oils being processed. Prior to the war the total solvent refining capacity in this country was about 72,000 bbl. per day. Construction of new facilities including solvent dewaxing, benzol, acetone and methyl ethyl ketone extraction, during the war has raised this figure to approximately 94,000 bbl., an increase of 32 percent.

Of increasing importance is the use of chemicals added in small percentages to lubricants to improve their quality. Improvements relate to maintenance of viscosity under changing temperatures, reduction of the deposit of varnish and sludge in engines, reduction of gum formation and corrosion, lowering of the temperature at which wax crystallization begins, reduction of foaming tendencies and improvement of film strength. Additives are combined with lubricants in minor proportions by weight, usually under

5 percent. However, at the annual lubricant production rate of a billion gals. the requirement for additives is appreciable, even though a certain percentage of oils is given no additive treatment. Additives which are used include methyl dichlorostearate, organosilicons, tricresyl phosphate, phosphorus and sulphur compounds, esters, ketones, straightchain hydrocarbon polymers, and metal salts of sulphonic and other acids. In addition to the above, numerous vegetable and animal oils such as tallow and rapeseed are compounded with petroleum lubricants to produce special products.

The solid and semi-solid lubricants produced in the refining industry are, of course, the greases. These are composed of petroleum oils and other materials in varying proportions. Lime, graphite, talc, aluminum oleate, aluminum stearate, rosin derivatives and various soaps of calcium, sodium and lead are frequently used.

WATER TREATING CHEMICALS

Great quantities of water are utilized for condensing vapors, cooling liquids and furnishing steam in refineries. Although conservation of water is practiced by the use of cooling towers, both make-up and recirculated water generally receive chemical treatment. Because of the wide variation of operations in refineries and in the character of water in different localities it would be futile to estimate the water requirements and chemicals consumed in a typical plant. However, an idea of the volume of water utilized (principally recirculated water) is obtained from the fact that several combination crude topping and cracking units having capacities of approximately 30,000 bbl. of crude per day have shown a water requirement ranging from 800 to 1,100 gals. per bbl. of crude processed.

The above figures do not take into account smaller water requirements for re-running and treating products from the crude distillation and cracking operations. Neither do they reflect the water needs of a conventional 100-octane aviation gasoline plant consisting of units for catalytic cracking, alkylation and butane isomerization. Such a plant may show a water rate of from 3,000 to 4,000 gal. per bbl. of gas oil charged to the cracking unit. Equipment for the manufacture of butadiene also uses much water. Plants producing butadiene have indicated water requirements varying between 700,000 and 1,200,000 gal. per ton of butadiene.

Chemicals for conditioning refinery water are required for softening boiler feed water, reducing corrosion in coolers and condensers and preventing or removing scale. The specific chemicals used, and their quantities, obviously depend on the nature of the water and the service for which it is needed. The consumption of water treating chemicals by two large refineries in different parts of the country furnishes a conception of the quan-

tities involved. Both plants run crude at rates close to 80,000 bbl. per day. One plant consumes 2,000,000 lb. of water treating chemicals annually. The other consumes slightly over 3,000,000 lb. The major chemicals in these instances are soda ash, lime, sodium silicate and various phosphates of sodium. On the basis of the above figures the requirements of these two plants range from 0.09 to 0.13 lb. of chemicals per bbl. of crude processed.

In recent years the disposition of refineries to install cooling towers or other cooling systems to conserve water has tended to concentrate the amounts of impurities in refinery water. Corrosion of equipment by water amounts to millions of dollars each year. Corrosion is not the only problem. Loss of heat transfer through fouling of piping and tubes by scale and organic growths is a matter of perennial concern. Depending on their purposes the following chemicals are included among refinery water treating agents: barium hydroxide, barium carbonate, calcium hydroxide, calcium hypochlorite, chlorine, copper sulphate, ferric sulphate, sodium chloride, sodium carbonate, sodium hydroxide, sodium bichromate, sodium phosphates, sodium sulphate, zeolites and organic compounds of chromium with certain sugars.

In addition to the processing chemicals used within refineries there are certain requirements for general purposes. Undoubtedly fairly large quantities are consumed annually for such services as insulating, painting, building concrete structures, neutralizing acidic waste waters and accidental spills of chemicals from equipment, flushing flammable gases from equipment and buildings, laboratory control and research, and fire protection. These services involve the use of asbestos, magnesia, oils, pigments, lime, ammonia, carbon dioxide, sodium carbonate and bicarbonate, aluminum sulphate and hundreds of chemicals used daily in laboratory and pilot plant work.

OUTLOOK

It was declared at the beginning of this survey that the need for chemicals in the petroleum refining industry is increasing. A basic reason for the increase is the steady annual rise in the volume of crude processed in the United States. The magnitude of future crude runs needed to meet the domestic requirements is indicated in a forecast of an industry committee presented last October by Mr. S. P. Coleman of the Standard Oil Company (New Jersey) in hearings before the Senate Petroleum Committee. The domestic demand figures for the principal petroleum products are shown in Table III. The total of the individual items for 1950, 4,955,000 bbl. per day, indicates that crude processing in 1950 to meet domestic demand will be 47 percent higher than the 1939 figure which, incidentally, was approximately 10 percent higher than in 1941,

the year on which the PAW chemicals survey was largely based. On the strength of the views expressed to the Senate it is to be expected that total chemicals requirements of the refining industry will increase appreciably. These requirements are without reference to the volume of crude necessary to be run to meet foreign demand, which has been estimated to reach 2,500,000 bbl. per day in 1950 exclusive of Russian needs. Just what portion of the demand American refiners will supply is by no means clear. The spread of economic nationalism goes on unabated, and in some countries is resulting in government-fostered refining industries.

Table III shows an expanding demand for the various types of gasoline and distillate oils, with smaller gains in lubricants. This points to increases in the consumption of chemicals used in manufacturing these products. It would be rash, however, to expect that chemicals currently competitive for a given service, such as sulphuric acid against additives for reducing gum formation in gasoline, will continue to maintain their relative positions. A fundamental feature of petroleum refining is continuous change.

Not only does the prospect of increasing petroleum requirements presage a heavier demand for chemicals, but the diminishing availability of preferred crude oils and the resultant need for turning to less desirable crudes also points to the use of more chemicals. Noteworthy in the United States during the war was the increased use of West Texas and

New Mexico crudes which, as a group, are typical of those containing high percentages of sulphur. Sulphur must be removed from, or rendered innocuous in, refined products like gasoline and distillate fuels. It has been reasonably predicted that the percentage of high-sulphur crudes processed in the United States will rise, not only because we have these crudes but also because certain large fields of foreign crudes of high sulphur content are expected eventually to contribute to the crude processed in this country. The United States has become a crude importing nation. These facts have a bearing on the future consumption of chemicals such as sulphuric acid, clays, caustic soda, ammonia, litharge and other materials.

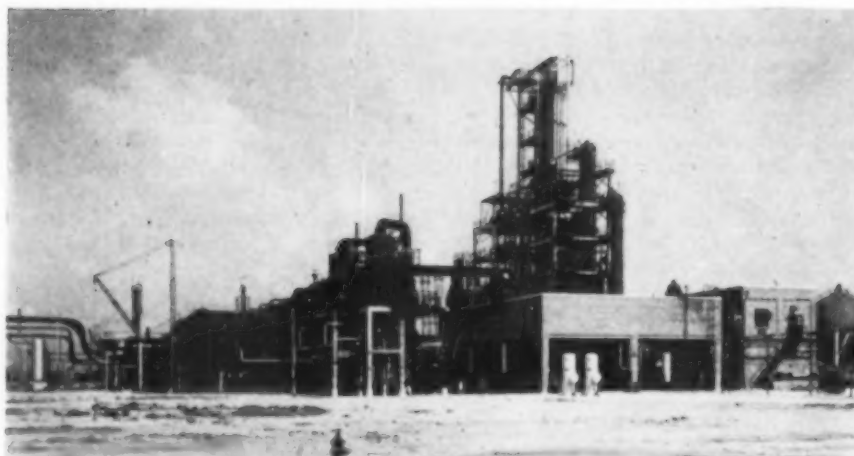
LOWER QUALITY CRUDES

Another impurity in crudes with which the refining industry must contend is the aggregate of solid matter designated as salt, which in some crudes amounts to 300 or 400 lb. per 1,000 bbl. The salt content of crudes from some fields tends to rise as the ages of the fields increase. The practice of acidizing old wells or poor producers to improve production is another factor tending to increase salt in crudes. Where refineries must process such oils, as a number are doing, they are faced with a growing problem. Many plants reduce the salt content before distillation by various means, but when appreciable amounts of salt enter distillation units trouble develops, particularly when hydro-

Table III — Estimated Increase of Petroleum Requirements in the U. S.*
(1,000 Bbl. per Day)

	1939	1947	1950	1951-1955
Motor fuel				
Passenger cars	953	1,045	1,360	1,440
Aviation	10	125	100	125
All other	559	700	760	725
Total	1,522	1,870	2,220	2,290
Kerosene	166	202	215	215
Distillate Oils				
Home heating fuel	265	402	510	538
Diesel fuel and others	105	198	214	240
Total distillates ...	370	600	724	778
Residual oil	895	1,125	1,142	1,160
Lubricants				
Automotive	34	41	46	48
Industrial	31	44	46	49
Total lubricants ...	65	85	92	97
Other products, losses	355	513	562	570
Over-all total	3,373	4,395	4,955	5,110

* Industry Committee Report to the Senate Petroleum Committee.



Pan American Refining Corp., Texas City, Tex., uses approximately 150 tons of sulphuric acid catalyst to produce 3,500 bbl. per day of alkylate

gen chloride is liberated by decomposition of the salt. This means the use of corrosion-resistant alloys in equipment or increased use of chemicals to neutralize the corrosive agents, or a combination of the two procedures.

Necessity of finding new sources of crudes is causing some refiners to process crudes of low gravity and low gasoline content. When gasoline or light gas oil is an important consideration the processing of low gravity crudes requires more cracking to produce the desired volume of products than would be the case when running high-gravity crudes. Greater amounts of oil cracked mean, of course, the consumption of more chemicals involved in protecting cracking equipment against corrosion and in treating the products.

QUALITY PRODUCTS

The need for products of higher quality to meet more severe conditions in modern automotive equipment points to the wider use of particular types of chemicals. Lubricants, for example, are being required to meet increasingly difficult engine conditions. Anti-foaming, resistance to oxidation, detergency and resistance to temperature effects upon viscosity are qualities being provided in lubricants by rapid developments in additives. Last November an official of a major oil company estimated that from 100 to 200 million lb. of additives will be used in lubricants during 1946. The use of additives in diesel fuels to improve burning characteristics in high speed engines is expected to rise.

The trend of gasoline engines toward higher compression ratios is encouraging the manufacture of fuels of higher octane number. This foreshadows a higher annual consumption of tetraethyl lead and, to the degree that they are competitive, gasoline components of higher octane number such as are produced by catalytic cracking, hydroforming, polymerization and alkylation. Aviation fuels much above 100 octane

number can be and have been made. Their production is only a matter of combining ingredients known during the war but not used for super-fuel manufacture on a large scale because of their relative scarcity. In the constant drive toward fuels of improved octane number the synthesizing of gasolines from components manufactured with the aid of chemicals has become general practice. Another tendency in gasoline technology is the widening use of additives, which have undergone marked development in the last five years.

All indications are that the synthetic rubber industry, at least as far as petroleum sources are concerned, is here to stay. Already competitive with natural rubber, the synthetic product is the subject of intensive research and development by tire manufacturers and refining companies. There is the prospect that costs can be lowered and quality enhanced to the degree that the refining industry will continue the profitable manufacture of synthetic rubber hydrocarbons and the use of catalysts, solvents and other chemicals involved.

The utilization of refinery gases formerly disposed of as fuel is increasing. Not only is burning the gases uneconomic relative to processing them into other materials, but the spread of cracking is making more gases available, particularly butylenes from catalytic cracking units. This is offering petroleum technologists an opportunity to make commercially feasible the utilization of gases as well as liquid fractions in the manufacture of many chemicals which themselves require the consumption of chemicals. That refiners are bent on exploiting their entry into the chemicals field is amply demonstrated by recent heavy expenditures on research facilities, creation of

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subsidiary chemical companies and installation of equipment for producing chemicals on a commercial scale (see *Chem. & Met.* Dec. 1945, pp. 121-8). The manufacture of chemical specialties, which include insecticides, floor waxes, anti-freeze compounds, radiator flushes and solvents, and the manufacture of a long line of chemicals from petroleum, is a field of growing importance in refining.

Taking the long range view, many large refineries and engineering companies are exploring processes for the conversion of refinery and natural gases into motor fuels, diesel oils and other products by adaptations of Fischer-Tropsch principles. Several refineries are operating pilot plants or semi-commercial plants. Highly interesting is a recent announcement that decision had been reached to build a \$15,000,000 plant at Carthage, Tex., to manufacture 5,000 bbl. per day of synthetic gasoline and other materials from natural gas from the East Texas area. Catalysts, sulphuric acid, caustic and probably additional chemicals will be required. In view of estimates that the natural gas reserves of the United States exceed 100 trillion cu. ft. it is logical that refiners should give close attention to this vast source of petroleum hydrocarbons for chemical processing.

ECONOMICS

Tied in with the future of synthesized and improved petroleum products, the manufacture of which is technologically feasible, is the obvious element of economics. Much of the capacity for isomerizing normal butane to produce a raw material for alkylation during the war is understood to be idle at present. A number of government-owned aviation gasoline future rise in demand for high-octane aviation gasoline, as well as current requirements, will keep in operation a certain proportion of existing aviation gasoline capacity, but various authorities have entertained no thought that all, or even a large part, of that capacity will be converted to the profitable manufacture of motor gasoline. The relatively low cost equipment should survive. An example is catalytic cracking, which in prewar years was in use for the manufacture of motor fuels.

Costs of production, volume of markets and prices not only play their part in determining how good the familiar petroleum products can be, but also determine how successfully the petroleum industry can expect to compete in the manufacture of the vast array of chemicals that can be made from petroleum. The ambitious research upon which refiners have launched is necessarily concerned as much with economic probabilities as with technical possibilities.

PROCESS EQUIPMENT NEWS

THEODORE R. OLIVE, Associate Editor

MAGNETIC FLOW GAGE

Flow in either direction within a pipe line is indicated automatically and magnetically (without the need for stuffing boxes or other packed parts) by means of a new flow gage introduced by the Ohio Pattern Works & Foundry Co., 2735 Colerain Ave., Cincinnati 25, Ohio. Available in sizes from $\frac{1}{2}$ to 2 in., the device is constructed of bronze with an aluminum plunger centrally located in a constriction. The plunger, normally centered by phosphor bronze springs, carries a magnet which transmits the position of the plunger to a pointer operating on a scale. Similar pointers and scales are provided on both sides of the device. At no flow the plunger and pointers are centered. The velocity of flow moves the pointer in the direction of flow, the extent of movement being dependent upon the flow rate. It is claimed that any viscosity of liquid can be gaged, at pressures as high as 150 lb.

SELF-PRIMING PUMP

Neither packing nor a mechanical seal is used in the new Type G vertical, self-priming centrifugal pump recently announced by The La Bour Co., Elkhart, Ind. This pump has but one running part, an impeller with an integral hydraulic seal. Since this seal uses the liquid being pumped as the sealing agent and seals only while the pump is in operation, the pump must be

installed so that no part of the suction line is above the pump inlet and there must be no pressure on the pump suction. Offset against this factor are the considerations that the pump never requires repacking; that its packing cannot be damaged by crystals, since it has no packing; and that the power consumed in accomplishing the sealing by centrifugal means is less than that consumed in a conventional stuffing box. Furthermore, since there is no flow of either air or liquid through the seal, the seal is subject to less wear than the impeller.

Through employment of this principle, there are no close running clearances needed in the pump. Sealing is accomplished by building beneath the impeller, and attached to it, a section which is the equivalent of a horizontal U-tube whirled about a vertical axis. Rapid rotation "packs" the liquid into the U under high centrifugal force, thus permitting a short U to seal the pump against the full pressure of the atmosphere, which is the maximum possible pressure on the suction side. The self-priming of the pump is accomplished by the same "Hydro-balance" principle employed in others of this company's pumps where liquid contained in the pump on starting is recirculated from the discharge back to the impeller until all air is expelled, after which the recirculation feature automatically balances out. The pump is stated to be suited to a variety of common applications such as sump or other drainage services, bilge, mine dewatering, irrigation, tank car unloading, tower service, transfer and similar work. With proper application it may be used in the handling of volatile liquids and the removal of liquids under vacuum. Two types are produced, a coupling-connected and a direct motor-mounted pump, the former being preferred for handling corrosive liquids.

VALVE POSITION INDICATOR

A new remote reading hydraulic valve-stem position indicator, developed by the Liquidometer Corp., Long Island City, N. Y., for the Navy, is now available for industrial applications. Indicators of this type can be used to show the open or shut positions of valves. The development was made in conjunction with Jenkins Bros., who developed the transmitter and hydraulically actuated mechanism for opening or closing the valves. The position of the valve stem is transmitted to the indicator dial through a Liquidometer temperature-compensated dual hydraulic transmission system which requires no outside source of power and which enables the indicator dial to be located at any reasonable distance from the valve. For example, all indicators for a group of valves can be located on a single panel adjacent to the remote valve operation transmitters for the valves.

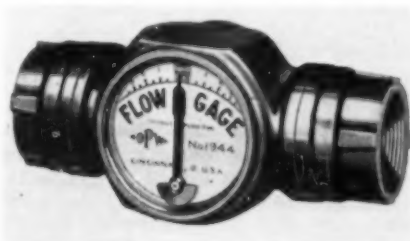
DEWPOINT RECORDER

To facilitate the use of controlled moisture-containing atmospheres, or of dehydrated air, the Surface Combustion Corp., Toledo 1, Ohio, has designed a new dewpoint recorder capable of providing a virtually continuous record of humidity within a temperature range from -70 to $+60$ deg. F. This recorder employs the principle of the dewpoint cup, having a mirrored surface which can be refrigerated at varying temperatures that are measured by a thermocouple. The stream of gas being tested is directed against the mirrored surface. Light from a light source directed on the mirror is reflected onto a photo-electric cell. As soon as fog forms on the mirror the photo-electric cell operates to shut off the flow of refrigerant, at the same time making an instantaneous point record of the temperature at which fogging occurs. This operation is repeated every three minutes to give a substantially continuous record.

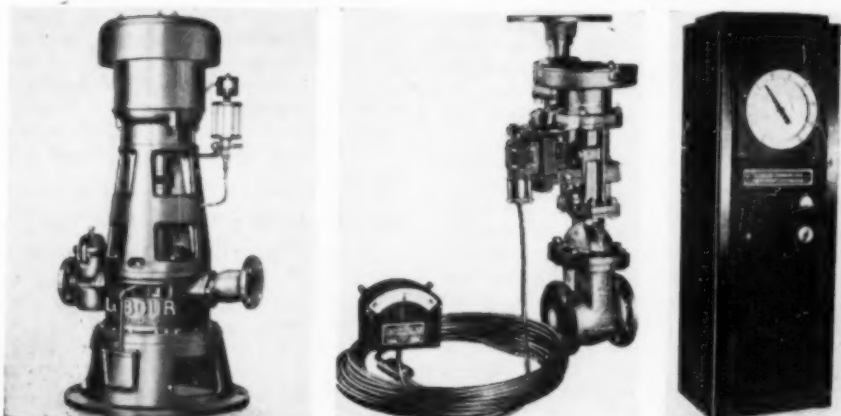
NICKEL-LINED PIPE

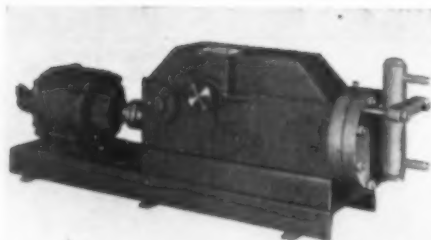
By means of a new process developed by the Bart Manufacturing Co., 227 Main St., Belleville 9, N. J., the interior of steel pipe can be provided with an electro-plated coating of nickel or other metals, in much greater thicknesses, it is believed, than has heretofore been possible. At present the process can be applied to pipes in sizes of 2 to 18 in., using a nickel lining of 0.010 to 0.020 in. Random length up to approximately 20 ft. can be produced, employing a process combining both electroplating and mechanical working. Internally plated pipe of this kind can be welded, reduced and bent, hot or cold, without destroying any portion of the internal lining. It is claimed that the lining is smooth, ductile and free from pores, and fully adherent to the base metal. Pipe

Magnetic liquid flow gage



Self-priming centrifugal pump
Remote valve position indicator
Dewpoint recorder for gases





Type DEL Wilson Pulsafeeder pump

of this character has the corrosion resistance of nickel, but the low cost, strength and fabricating characteristics of steel. Electro-Clad piping is said to cost only a fraction as much as solid pipe of corrosion-resistant alloys, making possible substantial savings where alloy pipe has been used heretofore, and extending the use of corrosion-resisting material to applications formerly prohibited by the high cost of alloy pipe.

FEED PUMP

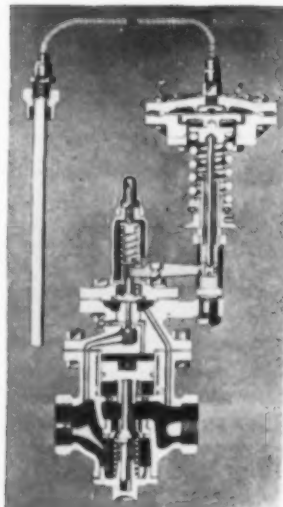
HEAVY-DUTY chemical solution feeding against high pressures up to 5,000 lb. per sq. in., can be accomplished by the new Type DEL Wilson Pulsafeeder, it is claimed by Lapp Insulator Co., Process Equipment Division, Le Roy, N. Y. This is a horizontal pump with a direct motor drive, the pumping head being of the reciprocating diaphragm type. The diaphragm is actuated by piston displacement through a hydraulic fluid, thus eliminating mechanical connections and packing glands. Stroke adjustment at any rate of flow from zero to the maximum can be accomplished while the machine is in operation, the motion being transmitted to the piston by an oscillating arm which utilizes full motor power without friction or vibration. Both single and duplex models are available in five sizes.

BULK TANK PREHEATER

PREHEATING of heavy liquids in bulk storage, including oil, tar, asphalt and similar heavy-bodied substances, can be accomplished with a new bulk tank preheater developed by the Rempco Co., 342 North Sacramento Blvd., Chicago 12, Ill. The preheater, illustrated herewith, can be made to fit any size tank having a manhole 16½ in. or larger in diameter. Built for use with either steam or hot water, it provides 38 sq. ft. of direct radiation surface, plus 10 sq. ft. of secondary shell heating surface. To make sure that the liquid being preheated flows over the coils before entering the suction line, a flow accumulator is built into the device.

TEMPERATURE REGULATOR

BOTH TEMPERATURE regulation and pressure control are obtained simultaneously with a new temperature regulator equipped with Duo-Matic control that is manufactured by Leslie Co., 279 Grant Ave., Lyndhurst, N. J. This feature is said to reduce installation cost and simplify piping materially. The regulator has a wide range thermostatic element that is adjustable over 100 deg. F. Since the valve is single-seated, it is suitable for positive dead-end control. Employing a metal diaphragm, the regulator has no bellows or packing gland, while all



Bulk tank preheater
Pilot-operated temperature regulator
Specific gravity indicator
Combustible gas alarm instrument

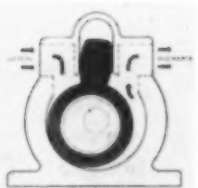
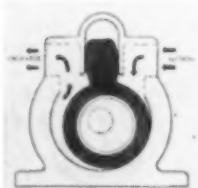
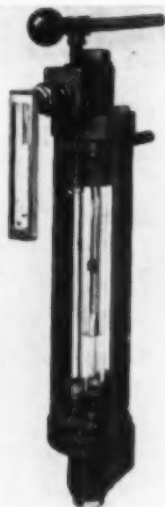
wearing parts are removable. The device employs a vapor-filled thermostatic element which controls a steam pressure pilot system that in turn positions the main steam valve. Outlet steam pressures are said always to be directly proportional to the change in temperature at the bulb, regardless of the volume of steam required by the heated equipment.

SPECIFIC GRAVITY INDICATOR

THROUGH an adaptation of its standard rotameter frame and fittings, Schutte & Koerting Co., Philadelphia 22, Pa., has developed a continuous-flow specific gravity indicator, as shown in an accompanying view. Liquid rises in a heavy-walled glass tube to a height determined by outlet pipes, then overflows and returns to the process. Specific gravity is indicated on a standard hydrometer within the tube. An integrally mounted thermometer enables temperatures to be read concurrently.

COMBUSTIBLE GAS ALARM

REMOTE location of the analyzer head is possible with a new combustible gas alarm system introduced by Davis Emergency Equipment Co., 45 Halleck St., Newark 4, N. J. The device detects the presence of combustible vapors or gases, gives an audible signal before the mixture with air becomes dangerous, and controls appliances such as shutting down machines, starting ventilating equipment, etc. The analyzer head is housed in an explosion-proof conduit located in the area being sampled. This enables the analysis to be made under actual temperature conditions at the point where the gas-air mixture exists and avoids possibility of causing condensation of all or part of an explosive vapor in drawing it through a long sample tube. The control cabinet, itself, may be located at any distance in a gas-free area. The system operates by bringing about combustion of the flammable mixture on the surface of a heated element, the combustion increasing the temperature and thus changing the electrical resistance of the filament so as to operate relays when the lower explosive limit is reached.



Cross-section of Eco pump

GEARLESS PUMP

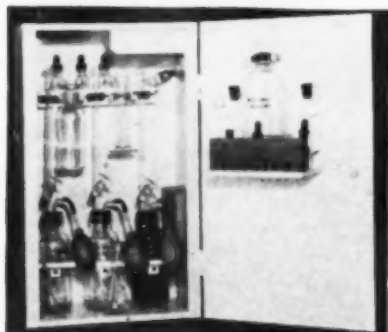
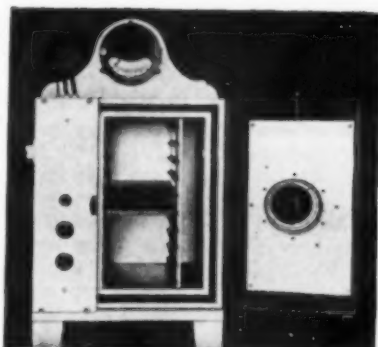
FOR WATER, light oil or other liquid circulating uses, Eco Engineering Co., 12 New York Ave., Newark 1, N. J., is producing an all-bronze pump provided with special bearings which require only water lubrication, eliminating the need for grease cups. The impeller, shown in an accompanying illustration, is a tough resilient material composed of several layers of laminated sections, vulcanized together under great pressure. It is claimed to permit abrasive particles to pass without harm to the pump. The pump is produced with a single impeller and standard ½-in. connection or a double impeller with standard 1-in. connection.

AIR SEPARATOR

ANY DESIRED separating capacity can be built up by using multiple units of the new Aerotec air-cleaning tube, a device of the small-diameter cyclone type for which exceptionally high precipitating efficiency is claimed. In this device clean air is exhausted from a central tube, while dust is precipitated from the bottom. Cleaners of this type are being employed, according to the manufacturer, for the recovery of valuable powders, for cleaning engine air intake, and for the removal of dangerous dust from industrial and chemical plant exhaust air. A single tube of this type has a capacity of 30 c.f.m. at 4 in. w.g. resistance.

OSCILLATING CONVEYOR

INTENDED primarily for the handling of sharp, jagged, abrasive, wet, oily or hot materials, a new oscillating-trough conveyor has been announced by the Link-Belt Co., 307 North Michigan Ave., Chicago 9, Ill. Briefly, the conveyor consists of a flexibly supported steel trough of rectangular cross-section which is oscillated back and forth by an



Junior-type water testing kit

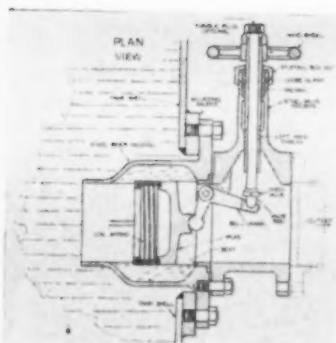
eccentric drive at a speed giving a forward travel movement of 20 to 50 ft. per min. for most materials. The conveyor can be built to handle a wide range of capacities. Conveying is done in a straight line, but separately driven sections of conveyor can be set at angles to one another. Conveyors can be installed either on a downward slope or horizontally. Lubrication is necessary only for the drive. Two types are provided, a short-hanger and a long-hanger type, the former suitable for installation in a shallow trench and the latter for floor mounting.

LABORATORY DRYER

AUTOMATIC temperature control is standard equipment in a new electrically heated laboratory dryer announced by Proctor & Schwartz, Inc., 7th St. & Tabor Road, Philadelphia 20, Pa. Materials are dried on trays or pallets, or hung on wires, sticks or hooks. Temperatures, which may range up to 300 deg. F., are produced by six electrical heating elements with hand switches to control each heating element. Positive circulation of the heated air is maintained actively throughout the interior of the cabinet by a direct motor-driven fan, with exhaust of moisture-laden air to enable humidity to be kept at the desired point at all times during drying. Heavy insulation is provided to prevent heat loss and assist in maintaining uniform temperature.

INTERNAL TANK VALVE

FOR THE protection of tank contents against run-off in the event of line breakage, the Johnston & Jennings Co., Cleveland 14, Ohio, has introduced the Oecco V-104 internal tank valve which is shown in an accompanying illustration. The valve is mounted on a saddle which is welded to the tank shell. Turning the handwheel forces the valve rod downward, actuating a bell crank and pushing the valve inward so



Ventilating hose compressed and open

as to compress the spring and permit fluid to pass outward. Reversing the handwheel reseats the valve under spring pressure, stopping the flow. If desired, a fusible plug can be provided which melts at a critical temperature, releasing the valve rod and cutting off the flow automatically in case of fire. The valve, made with or without the fusible plug in sizes from 4 to 10 in., enables the flow to be shut off to make repairs or alterations in the line, in addition to its fire protection function.

This company has also announced the Oecco V-404 air relief valve for installation at high points of pipe-line systems to remove air or gases trapped in the line which might otherwise reduce line capacity or even block the flow of liquid entirely. This consists of a riser pipe which is installed above the high point in the line so as to fill with liquid. A float-operated trap is provided, which traps off any accumulation of air or gas, but closes under float action before liquid can discharge from the air release port. Sizes range from 2 to 12 in.

GAS-POWERED TRACTOR

IN ANNOUNCING the resumption of production of industrial, gasoline-powered tractors for civilian use, the Towmotor Corp., Cleveland, Ohio, has announced a new model tractor, illustrated herewith, which features new compactness and maneuverability, especially for use in confined areas such as narrow factory aisles. New safety features have been provided, eliminating many hazards in moving materials. Since 1941 the company has been concentrating its production facilities on the manufacture of lift trucks rather than tractors.

VALVE ACTUATOR

BENDIX Hydrodine Actuator is the name of a new hydraulic power-operated valve actuator produced by Pacific Division, Ben-



Electrically heated laboratory dryer
Internal tank valve
Improved industrial tractor
Hydraulic actuated valve

dix Corp., North Hollywood, Calif. The unit incorporates a simple hydraulic system which produces force in a straight line by means of a hydraulic cylinder, to open and close the valves. As the valve seats the hydraulic pressure continues to build up, so as to pressure-seal the gate against leakage. Pressure is then hydraulically locked in the cylinder and only reverse action will unlock it. Should pressure drop from any cause, it is automatically re-established immediately. For emergency use an independent hydraulic system with a hand pump is provided.

VENTILATING HOSE

SECTIONAL construction permitting assembly of any desired length from 24-ft. long sections, which are readily coupled and uncoupled with only the hands, is featured in a new type of ventilating hose known as Portovent and manufactured by the American Ventilating Hose Co., 15 Park Row, New York 7, N. Y. Supplementing the more rigid and non-reinforced types previously made by this company, the new hose meets requirements for metal-reinforced ducts of light weight and large diameter which can be compressed into small space for transportation, yet stay open around sharp bends. The reinforcement consists of rings spaced from 2 to 5 in. apart, varying according to the diameter of the hose. These are held firmly in place around their entire circumference by the neoprene-base compound which also covers the entire inside and outer surfaces of the hose. Available diameters are from 5 to 24 in.

WELDING ELECTRODES

NEW WELDING electrodes for cast iron and for the Inconel side of Inconel-clad steel have been announced by the International Nickel Co.'s new electrode plant at Bayonne, N. J. The first of these, Ni-Rod, is said to mark a forward step in the art of making machinable welds in cast iron. The second, designated as No. 133, is an 80-20 nickel-chromium electrode.

WATER TESTER

KNOWN as the "Testmaster Junior," a compact and economical, but completely equipped testing unit for water analysis control, has been developed by Tru-Test Laboratories, Inc., 261 South Third St., Philadelphia 6, Pa. The unit permits the

determination of hardness, alkalinity to P and M, and chlorides, for maintaining suitable boiler feed or process water conditions. If desired, the cabinet can also accommodate, without modification, testing equipment for phosphates and pH. Thus, the unit is potentially available for all normal water control tests except dissolved oxygen.

PILOT PLANT DRYER

FOR SMALL-SCALE spray-drying applications in laboratory and pilot plant work, requiring water evaporation capacity of 8 to 15 lb. per hr., the Model 10 S "Research" spray dryer has been introduced by Research Equipment Engineers, 50 Broad St., New York 4, N. Y. The dryer is supplied in a completely "packaged" unit, ready to use and requiring a minimum of floor space. The spray compartment of the dryer is cylindrical, with a flat top, 30 in. in diameter, 60 in. high. It is insulated and the interior surface is of stainless steel. A rectangular sight glass provides visibility of the spraying operation. The heated air assembly includes an air filter, a steam coil, blower and the necessary duct work. The steam supply is controlled thermostatically. Air is provided for atomization and for liquid pressure by means of a 3 c.f.m. air compressor controlled by a pressure switch. A tank holding two or three hours' requirement of the liquid to be dried is constructed of stainless steel and can be provided with a preheating coil or mixer, if desired.

CONDUCTIVITY CELL

FOR INDUSTRIAL measurement of the electrical conductivity of flowing liquids, Industrial Instruments, Inc., 17 Pollock Ave., Jersey City 5, N. J., has announced a positive flow-type cell for use with the company's electrolytic conductivity controllers and recorders. Compact and inclosed in a hinged steel case, the unit consists basically of a tubular glass conductivity cell with concentric cylindrical platinum electrodes, and a continuous-duty stainless steel centrifugal pump. The unit may be mounted either on the outside wall of a tank or on an instrument panel at a distance from the tank. Connection to the source of liquid is made with $\frac{1}{2}$ in. O.D. Saran or metal tubing. Since the unit is installed outside the tank, there is no danger of breakage of cells by moving parts in the tank itself.

EQUIPMENT BRIEFS

DEVELOPED originally for the measurement of relatively small flows, the Rota-Sleeve type of area meter manufactured by Fischer & Porter Co., Hatboro, Pa., is now available for large flows of liquids and gases. For large flows the instrument employs a metal sleeve which fits into standard pipe tees in sizes from 3 in. up. V-port flutes with the greatest area at the top are built into the sleeve to offer a variable flow area for fluid passage. Flow enters the bottom of the sleeve, causing the flow-indicating float to move upward so that the float assumes a position proportional to the actual rate of flow. The device indicates by means of a pointer carried by the float that is visible within a transparent tube above and out of the line of flow. The company's Stabl-Vis

float can be used if desired to eliminate the effect of viscosity variation.

VIKING INSTRUMENTS, Inc., Stamford, Conn., has announced the Viking Type R-18 safety control system which is available to shut down diesel engines when the temperature of the circulating water becomes too high or when the lubricating oil pressure falls too low. The device is self-operating, requiring no electric power or additional accessories. The actuating element is a bellows which expands upon drop in pressure, in turn releasing a trigger so that a rod and spring operate the fuel pump or governing lever to shut down the engine. This drop in pressure may be caused by failure of the oil supply or by opening of a thermostatic bypass valve due to increase in circulating water temperature.

BUILT on the principle of the household can opener, but much more powerful and much stronger, a low-cost steel drum opening tool is being produced by Merrill Bros., 56-02 Arnold Ave., Maspeth, N. Y. Known as the O'Brien drum opening tool, it cuts away the top of a steel barrel or other metal container, folding back the edges and producing a smooth, even hole.

IF DESIRED, a magnetized strainer basket can be provided to intercept metal particles in a new Y-type pipe line strainer recently brought out in cast iron, semi-steel, steel and cast bronze by the J. A. Zurn Manufacturing Co., Erie, Pa. The unit can be installed in almost any position in a pipe line and is available with or without a cleanout plug or threaded blow-off connection.

SEVERAL new gaskets based on asbestos have been announced by Greene, Tweed & Co., 238th St. & Bronx Blvd., New York 66, N. Y. Included is a type of high-pressure folded asbestos gasket, asbestos metallic sheet packing, and asbestos metallic gasket tape. Woven cloth produced from brass wire and asbestos yarn, coated and cemented with heat-resisting material, is folded into shape for the first type, or is available in the form of sheet packing or tape for the second and third types.

ALTHOUGH its heating chamber is only a 3-in. tube, inside dimensions, the Mighty Midget electric furnace produced by K. H. Huppert Co., 6830 Cottage Grove Ave., Chicago 37, Ill., is nevertheless equipped with automatic temperature control to maintain any furnace temperature between 200 and 1,750 deg. F. The furnace operates on 110 volts a.c., with a current consumption of 500 watts. The balanced, stepless control employed in this furnace is now being applied, according to the manufacturer, to various of the larger furnaces of his line.

A DOUBLE COATING of Ameripol, the type of synthetic rubber produced exclusively by the B. F. Goodrich Co., Akron, Ohio, is being employed in the construction of a light-duty industrial apron said to give maximum protection against oil, acid, caustic and water. This apron is claimed to be unaffected by 24 hours' complete immersion in 50 percent concentrations of sulphuric, nitric

or hydrochloric acids, or 25 percent solutions of caustic soda. It is said to be highly resistant to abrasion.

A COMPLETE LINE of skid platforms, deck pallets, and nesting rings is being made in all sizes by the Phillips Mine & Mill Supply Co., Pittsburgh, Pa., for use with any type of lift truck. Skid platforms are available with corrugated decks of steel, using electric welded construction. Steel pallets are produced with both top and bottom decks of corrugated metal, or with a pipe understructure. Wood-deck skids are available, built up on heavy-duty metal frames.

FIVE DIFFERENT speed ranges can be secured in each of four different models of the improved Model U hand tachometer introduced by the Herman H. Sticht Co., 27 Park Place, New York 7, N. Y. Various models are capable of covering ranges from 30 to 48,000 r.p.m.

PORTABLE PYROMETER

TEMPERATURES of liquids, as well as of ovens or atmospheres up to 1,200 deg. F., may be measured with a new portable hand pyrometer manufactured by Roller-Smith Co., Bethlehem, Pa. The pyrometer has been employed in Navy work, but is expected to serve widely in industry. It consists of an indicating instrument equipped with a handle to which the lance-type sensitive element is attached. Extremely rugged construction is claimed.

WELD FITTINGS

SOCKET-WELDING pipe fittings in stainless steel, for the full size range from 1 in. to 14 in., are being produced by Electric Steel Foundry Co., Portland 10, Ore. Through the elimination of flanges and bolts, the use of such sockets saves weight, while in many cases the employment of fittings of this type enables lighter gage tubing or fabricated pipe to be used, rather than heavier walled flanged pipe.

NITRATE TESTER

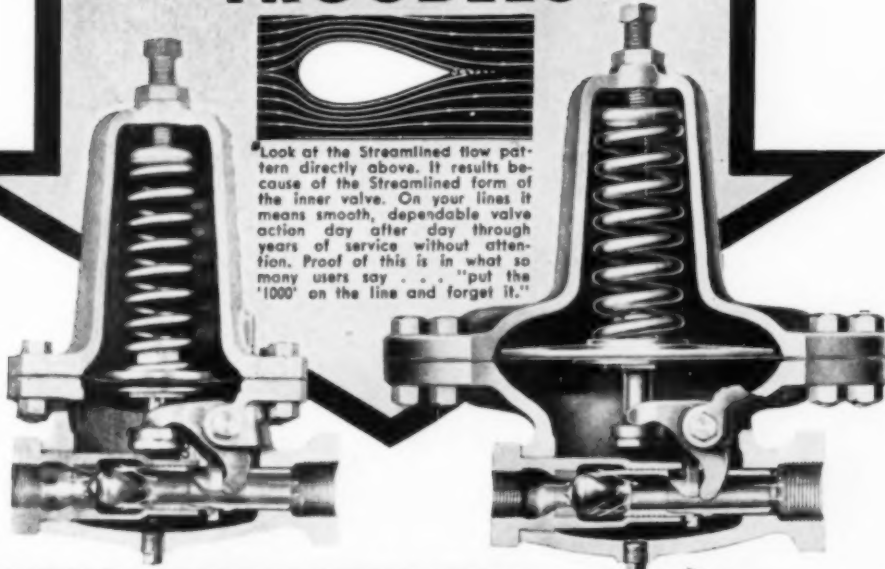
A TESTER of the comparator type is available from W. H. & L. D. Betz, Philadelphia 24, Pa.; and from W. A. Taylor & Co., Baltimore 4, Md., for the determination of nitrate ion in boiler water. The test procedure was established in the Betz laboratory and the equipment designed by W. A. Taylor & Co. The device finds particular application in routine plant control of the nitrate-hydroxide ratio in boiler water for the prevention of embrittlement. The range covered is from 0 to 100 p.p.m. of nitrate.

CORRECTION

UNDER the title of "Cooling Unit," an item on page 128 of our September, 1945, issue misinterpreted the principle of operation of the Fin-Fan cooling unit manufactured by The Fluor Corp., Ltd., Los Angeles 22, Calif. This unit employs Griscom-Russell K-Fin tubing for the cooling of process fluids at pressures up to 5,000 lb. per sq. in. and temperatures to 1,500 deg. F. Cooling is accomplished by forced draft provided by variable-pitch fans, and not by a combination of forced draft and water evaporation as stated.

HERE'S HOW PROCESSING LINES ARE

Fortified AGAINST VALVE TROUBLES



Look at the Streamlined flow pattern directly above. It results because of the Streamlined form of the inner valve. On your lines it means smooth, dependable valve action day after day through years of service without attention. Proof of this is in what so many users say . . . "put the '1000' on the line and forget it."

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVES

When you put this Streamlined construction on your lines you have no complicated parts to get out of order, no small ports or passages to clog up. There are no close fits. It's straight line flow all the way — flow that gives you maximum capacity, close delivery pressure control, and tight closures — flow that saves you money all along the line — flow that means elimination of failures — speedier production and no spoilage.

CASH STANDARD
CONTROLS..
VALVES

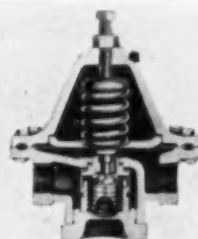
A. W. CASH COMPANY
DECATUR, ILLINOIS



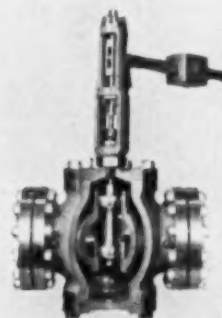
BULLETIN 962—features the CASH STANDARD Streamlined Type 1000 Pressure Reducing Valve—illustrates the streamlined construction and tells why you get exceptionally long, trouble-free, low-cost performance. Points out why you get no turbulence and therefore can meet peak demand at all times. Explains why straight-line flow gives you maximum capacity, close delivery pressure control, and tight closure.

**BULLETINS
AVAILABLE
ON OTHER
CASH STANDARD
VALVES**

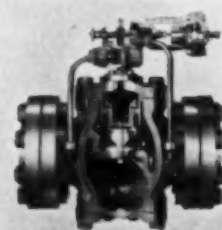
Send for them



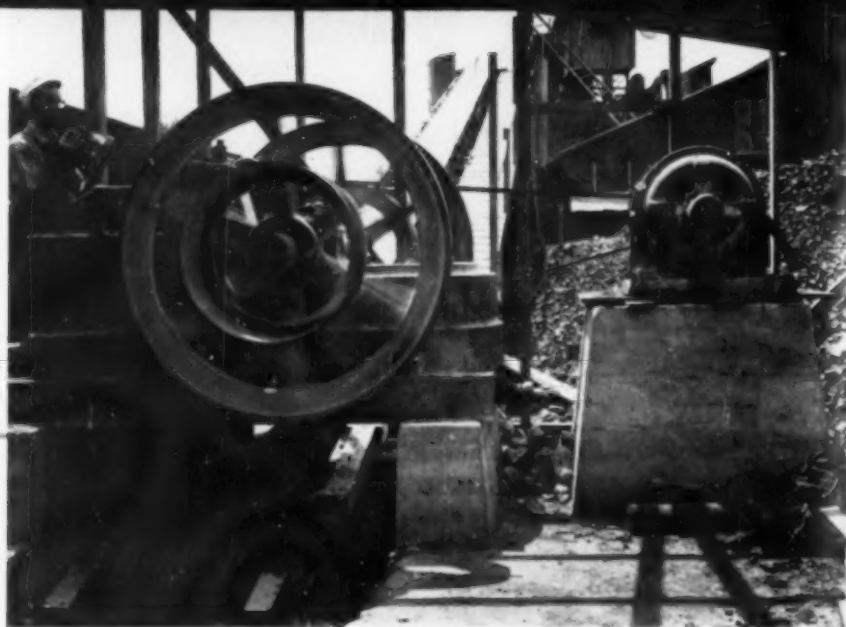
BULLETIN 950—features the CASH STANDARD Type D Single Seat pressure Reducing and Regulating Valves for use with most fluids. Shows simple inner working parts that save in maintenance. Diagram explains how valve works. Blueprint shows simplicity of installation.



BULLETIN 965—features the CASH STANDARD "42" Series—a complete line of balanced lever valves for handling almost anything that will flow through a pipe except some injurious chemicals. Two full pages show 16 installations with descriptions.



BULLETIN 967—features the CASH STANDARD Type 11 Condenser Water Regulator—self-contained—pilot-operated for controlling the flow of cooling water to condenser coils. Used with water or air—with any gas or oil that is non-corrosive—and with all refrigerating fluids. Blueprints show installation at outlet of condenser and at inlet. Capacity charts are shown.



1 Strontium sulphate ore in large chunks, received in bulk at the Philadelphia plant is first reduced to $\frac{1}{4}$ in. mesh in this jaw type crusher

STRONTIUM CHEMICALS

FOUNDED in 1876 to supply museums, institutions, and scientific groups with minerals, the Foote Mineral Co. has long been a major producer of alkaline earth compounds. Not least important of these are the strontium chemicals, manufactured by this company for nearly thirty years. First imported from England, strontium ores are now found in various deposits in this country. Most abundant is celestite, a natural strontium sulphate, which is shipped from the mines in Texas to the Philadelphia plant where strontium chemicals are manufactured for a wide variety of purposes. Production of these little known chemicals during the war exceeded 200 tons per day.

Perhaps the most important commercial use for these compounds is in the manufacture of pyrotechnics such as fireworks, flares and emergency signals of various kinds in which strontium chemicals burn to produce a red light. Marine, aviation, and military needs have dominated this field during the war, but all forms of transportation use emergency signals to a considerable extent, while actual fireworks for display purposes consume comparatively small quantities. Strontium compounds are used for a variety of other purposes such as fluxing agents on welding rods, as an ingredient in ceramic glazes and as a compound in certain lubricants.

The basic raw material, strontium sulphate, is first converted to the pure carbonate which finds greatest use as an intermediate from which all other salts are prepared. The ore is crushed, dried, and finally ground to

increase its reactivity. A mixture of ore and sodium carbonate solution is heated in reactor tanks where strontium carbonate is precipitated, after which the slurry is filtered on a rotary drum filter to remove sodium sulphate liquor. The strontium carbonate is treated further in purifying tanks to dissolve barium and calcium salts and is filtered again to remove these impurities. After the filter cake is dried in a truck type tunnel dryer it is ground in a micropulverizer and packaged.

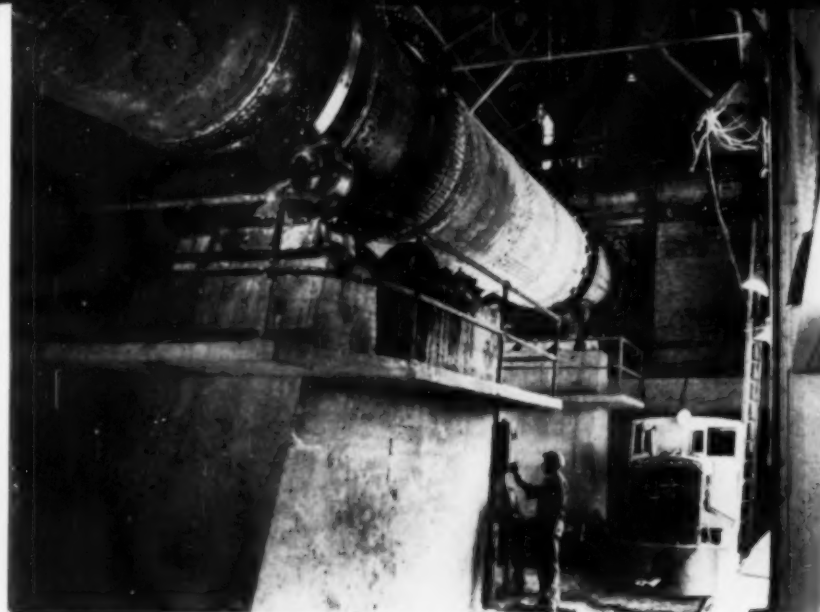
Strontium chloride, used principally in welding fluxes and steel treating salt baths, is prepared from the carbonate by reacting the purified filter cake with hydrochloric acid. The slurry is filtered in a plate and frame filter press and the filtrate is evaporated to crystals in a single-effect or open-pan evaporator before it is ground in a micropulverizer.

The hydroxide which is primarily an intermediate for use in the manufacture of phosphorescent compounds and mixtures, in the production of depilatories, and for use in certain fluorescent lighting, is produced by reacting strontium chloride with caustic soda wherein strontium hydroxide crystals are formed. These are separated from the liquor by centrifuging and may be packaged directly or may be dehydrated in a tunnel dryer. Other strontium compounds are manufactured in a similar manner. For instance, the oxalate and tartrate may be formed by reacting the strontium carbonate with oxalic or tartaric acid; strontium stearate results from reacting strontium hydroxide with stearic acid.

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ENGINEERING

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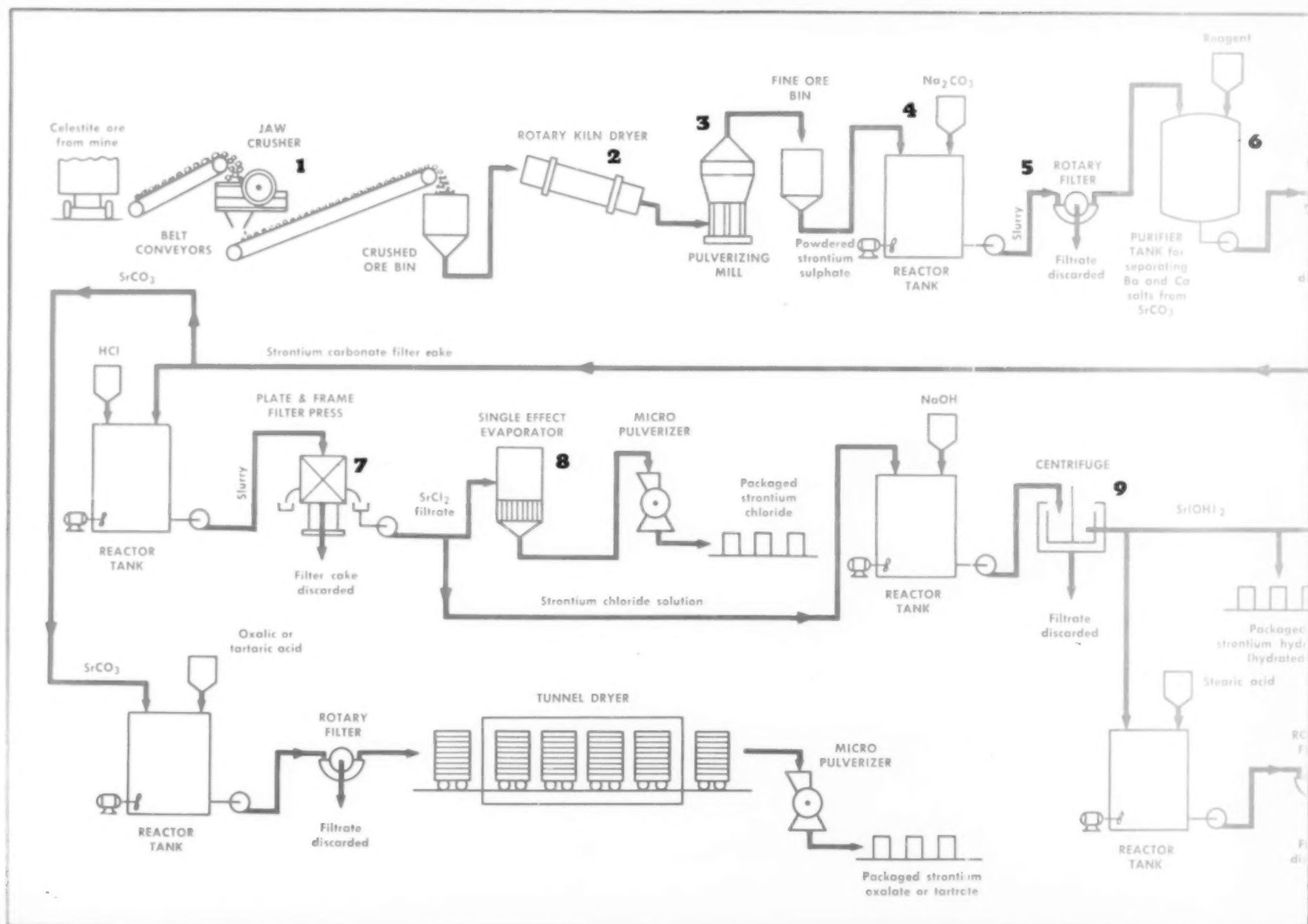
2 Before pulverizing, the ore is dried to about 0.25 percent moisture in this oil fired rotary kiln at temperatures near 1,200 deg. F.

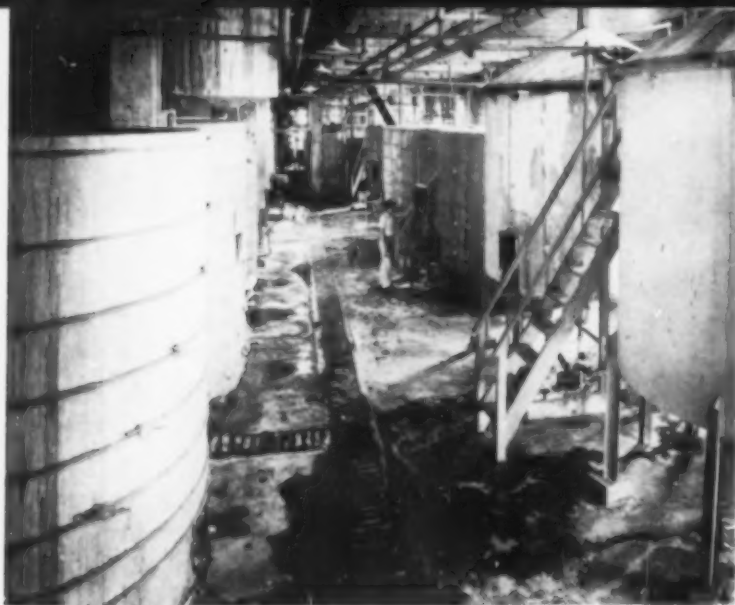


3 Reactivity is increased by pulverizing (90 percent through 325 mesh) in this Williams mill



4A Strontium carbonate is precipitated powdered ore is mixed with sodium carbon





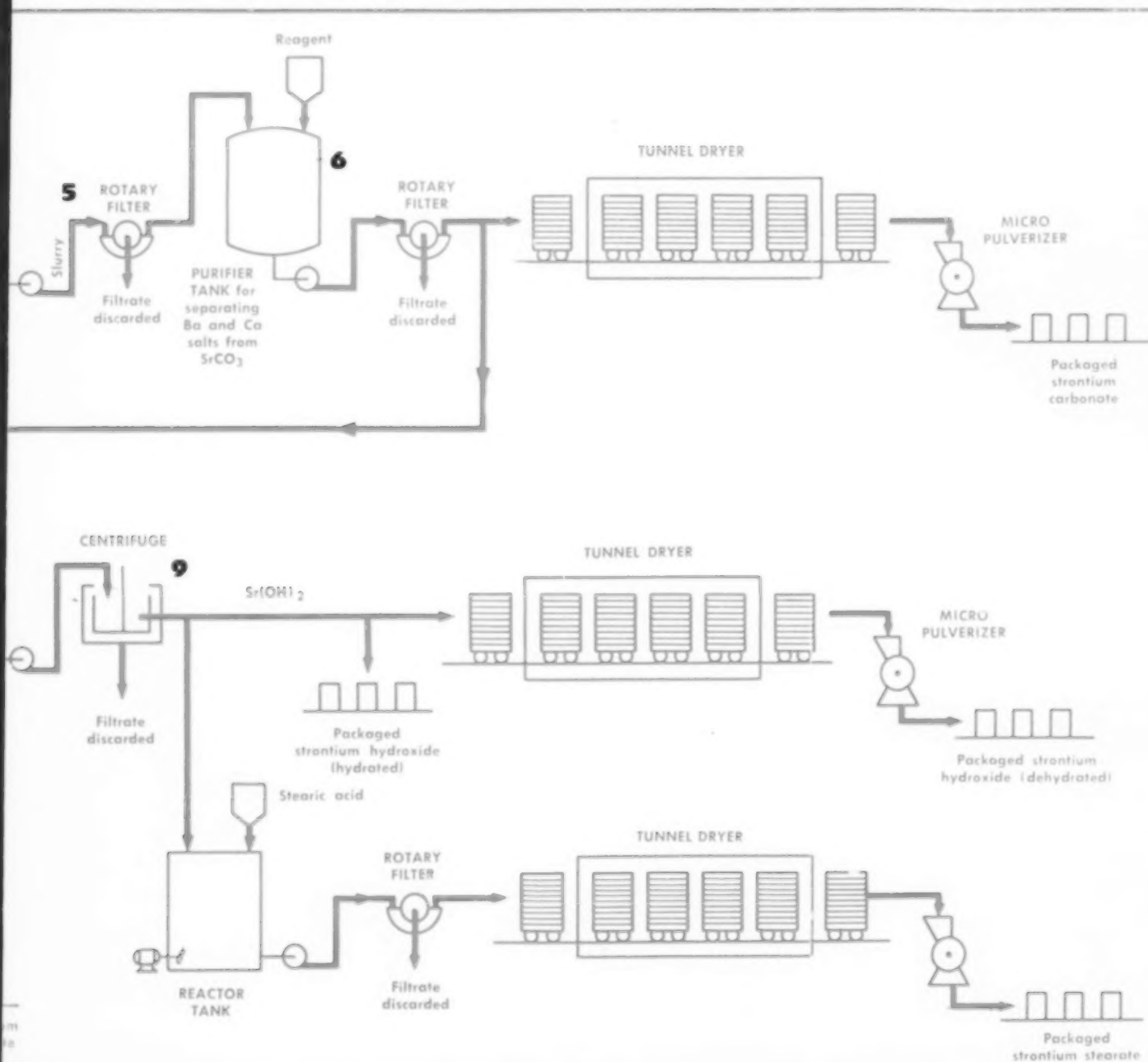
4A Strontium carbonate is precipitated in reaction vessels when powdered ore is mixed with sodium carbonate solution and heated

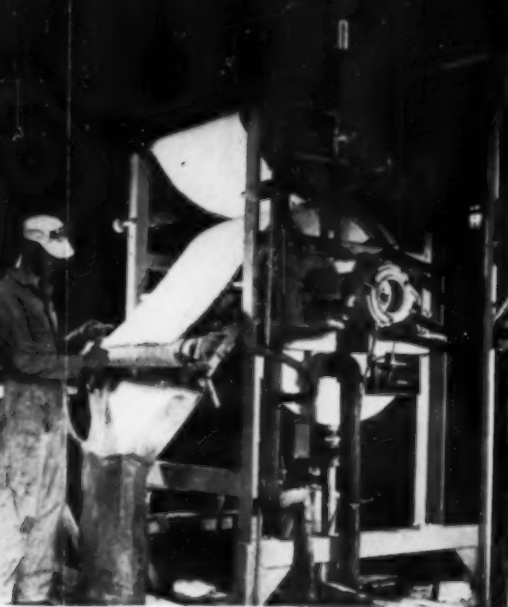


4B Reactors equipped with side entering agitators keep reaction components in close contact



5 The filtrate is discarded

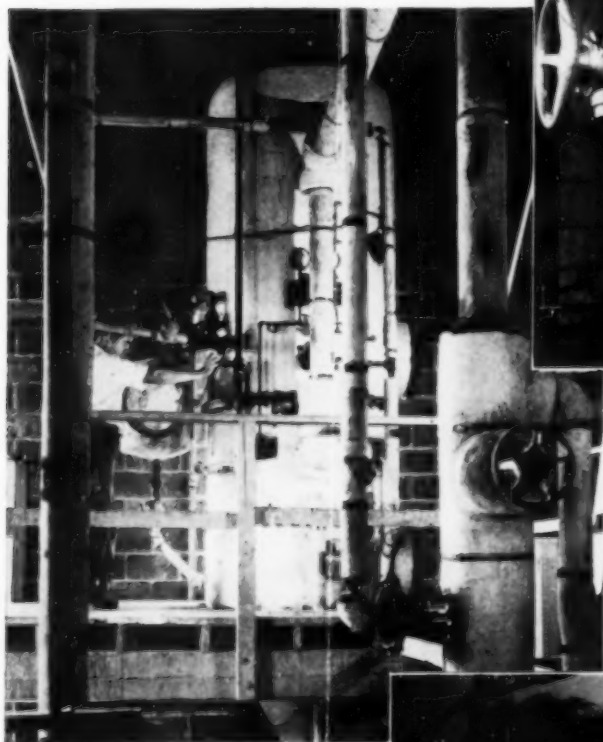




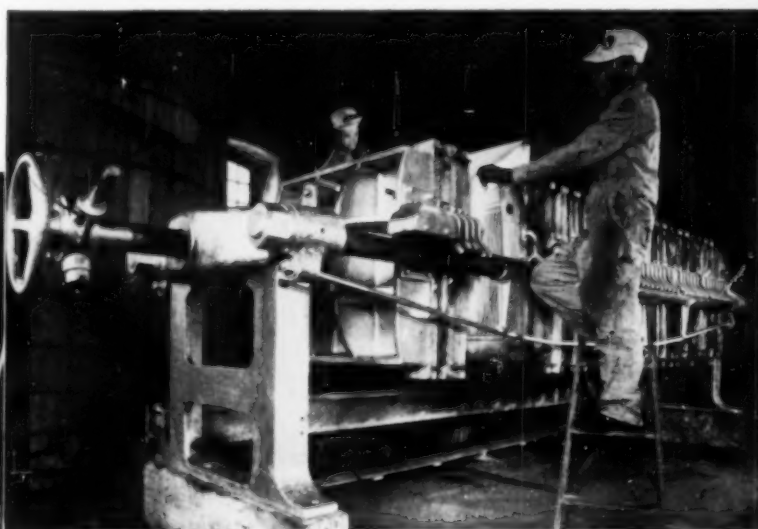
5 The filtrate containing sodium sulphate is discarded but the cake must be further purified



6 Separation of barium and calcium salts from strontium carbonate is possible after treatment in these vessels where these salts are dissolved



9 Right—Caustic soda solution with strontium chloride reacts to yield crystalline strontium hydroxide which is separated from the salt liquor in centrifugals



7 Strontium chloride, formed by reaction of the carbonate with dilute HCl is separated from insoluble material in this filter press

8 Left—Batch-type single-effect evaporator is employed to concentrate the liquor and crystallize strontium chloride from solution





Solar Exhaust Manifold *"In Action"*

THE ABOVE PHOTOGRAPH, taken in complete darkness without artificial lighting, dramatically shows the intense heat Solar airplane exhaust manifolds experience in service. This punishment goes on hour after hour for thousands of hours—a striking testimony to Solar workmanship.

During the past 15 years, Solar has fabricated over 300,000 engine sets of airplane exhaust equipment representing more than 1000 designs. The "know-how" gained extends over all stainless steel forming techniques from deep drawing to precision casting.

If your problem is manufacturing heat or corrosion resistant products from stainless steel or other high temperature alloys, consult Solar. Wire or write for helpful information.



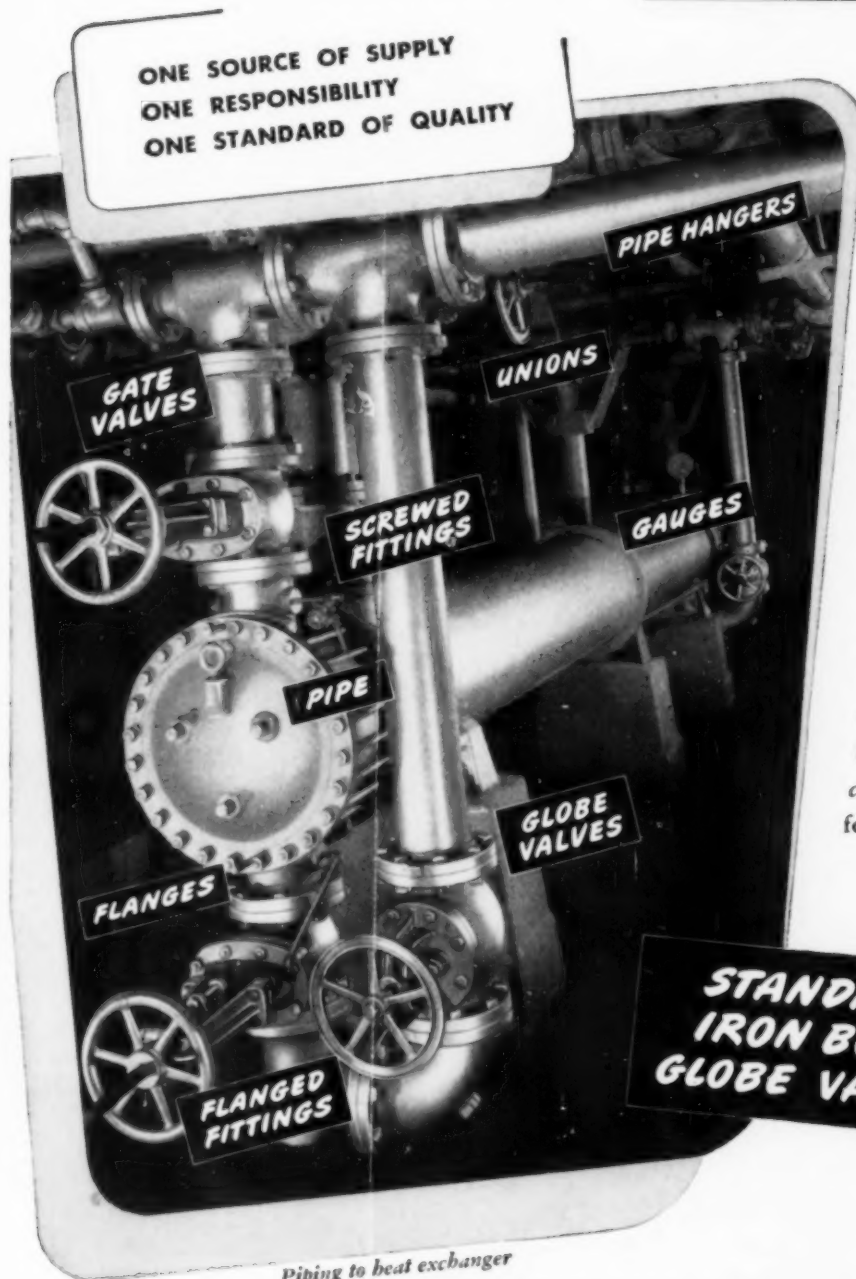
SOLAR
STAINLESS STEEL PRODUCTS



SOLAR AIRCRAFT COMPANY ★ SAN DIEGO 12, CALIF. ★ DES MOINES 5, IA.

For "User's Choice" of Piping Materials ... it's the Complete CRANE Line

ONE SOURCE OF SUPPLY
ONE RESPONSIBILITY
ONE STANDARD OF QUALITY

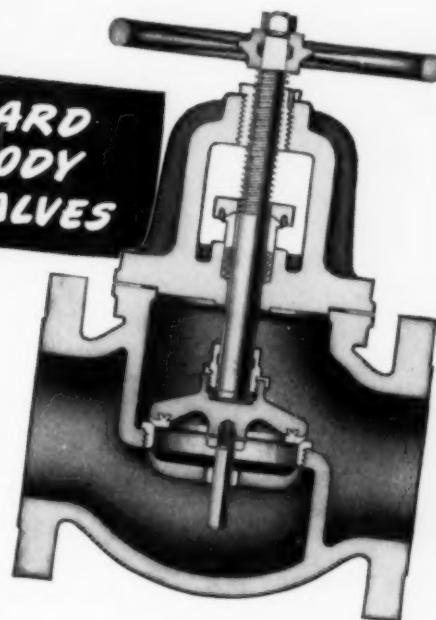


Piping to heat exchanger

Piping systems operate under varying conditions. What conditions should dictate your choice of piping materials, you can best determine. Then Crane helps you meet those specific requirements with the world's largest line of valves, fittings, pipe and piping accessories for all applications. By demonstrating the merits of all types of materials, Crane, with 90 years' experience, enables you to choose correctly for every need.

Ordering from the Crane line simplifies all piping jobs. Your Crane branch or Wholesaler supplies all materials. You're sure to get a better installation and better performance with all parts of uniform quality, backed by single responsibility. This complete Crane service is made-to-order for your peacetime program.

STANDARD
IRON BODY
GLOBE VALVES



SERVICE RECOMMENDATIONS:

Crane Standard Iron Body Globe and Angle Valves meet all general service requirements with working pressures up to 125 pounds steam. Brass-trimmed valves are recommended for steam, water, and fluids non-corrosive to brass or iron; all-iron valves for fluids that corrode brass but not iron. Also available with choice of composition discs for steam, hot water, cold water, air, oil, and other services. In sizes from 2 in. up—with screwed or flanged ends. Crane also makes iron body globe and angle valves in all-iron; with brass trim; and with composition disc; in sizes from 1/4 to 2 in. Rated at 150 pounds steam, 250 pounds cold. See your Crane catalog, pages 143 to 151.

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. • Branches and Wholesalers Serving All Industrial Areas

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

One Hundred Wartime Projects involving 153 plants
completed by GIRDLER'S Gas Processes Division:

CARBON DIOXIDE MANUFACTURE.....	27 Plants
CARBON DIOXIDE REMOVAL.....	3 Plants
HYDROGEN MANUFACTURE.....	37 Plants
HYDROGEN SULPHIDE REMOVAL FROM GASES.....	21 Plants
HYDROGEN SULPHIDE REMOVAL FROM LIQUIDS.....	3 Plants
NITROGEN MANUFACTURE.....	13 Plants
GAS DEHYDRATION.....	17 Plants
BUTADIENE MANUFACTURE.....	3 Plants
OTHER CONSTRUCTION JOBS.....	13 Plants
ENGINEERING DESIGN.....	13 Plants
CATALYST FOR SPECIAL PURPOSES.....	3 Plants
Total.....	153 Plants

"Proof of the pudding..."

Work done is the best evidence of ability to do. So we give you a candid list of some of the projects completed by Girdler's GAS PROCESSES DIVISION during the war period.

One hundred and fifty-three plants, engineered, constructed or supplied by Girdler for the United States government, for Allied na-

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NEW PRODUCTS AND MATERIALS

R. W. PORTER, Assistant Editor

PENETRATING AGENT

DEVELOPED for the purpose of aiding the processing of nylon thread and yarn, phosphate No. 12 is a dye-carrying penetrant which simplifies the dyeing of nylon thread and yarn. This new penetrating agent, manufactured by the Victor Chemical Works, Chicago, Ill., is a member of the alkyl phosphate family. It provides even penetration of the nylon thread or yarn under treatment and may be used in the dyeing equipment already standard in most modern plants.

Prior to this development, nylon cakes had to be unwound and skeined before dyeing, and then rewound on the spools for further operation. Addition of only 0.4 percent of phosphate No. 12 to the dye solution makes it possible to dye the nylon cakes without unwinding. This makes it possible to avoid skeining and rewinding, thereby saving labor and possible spoilage due to tangling of the skeins. This compound is said to be stable in the presence of both acids and alkalis, is neutral, and has been found compatible with other constituents of the dyeing bath in a variety of experiments. It is being produced in a semi-works unit at the present time, but large scale manufacturing facilities are planned.

DISINFECTANT

A WARTIME product developed to sterilize surgical instruments without heating has recently been disclosed. This new odorless sterilizing and disinfecting agent is adaptable to many purposes and is now available for commercial use under the brand name Timsol from Theo. Ross and Associates, Los Angeles, Calif. The active ingredients of Timsol concentrate consist of "quaternary ammonium compounds." For many applications it may be used in such small quantities as 1 oz. to 5 gal. of water. In this concentration it is non-toxic, harmless, and non-irritating to humans, or to any surface unaffected by water. It requires no wiping and does not stain or discolor brassware, silverware, dishes or utensils. It is expected that wide use of this material may be found in restaurants, bars, dairies, hotels, hospitals, bottling and food processing plants for the purpose of sanitation and for sterilization of dishes, utensils, etc.

ADDITIVE

A CLASS of organic compounds known as pour point depressants has become increasingly important to lubricating oil users during the past few years. A new compound, Tretolite PD-21, developed by the Tretolite Co., St. Louis, Mo., is a general purpose pour point depressant having strong action on a wide variety of oils including conven-

tionally refined and solvent refined neutrals, bright stocks and blends. This additive does not increase the carbon residue values and oxidation numbers of oil mixtures and may be used in high percentages where extreme low stable pour-points are required. This material has undergone extensive laboratory and road tests and is now commercially available.

WEED KILLER

AFTER two years of research and experimenting, the Sherwin-Williams Co., Cleveland, has announced its new product called Weed-No-More. Consisting basically of dichlorophenoxy acetic acid, Weed-No-More differs from other weed eradicators now on the market, in that it is of the butyl ester type and not of the sodium salt or carbo-wax type. Applied in a spray to golf greens and lawns, this new material is said to have a lethal effect upon all weeds with broad leaves, especially dandelion, rag weed, poison ivy, poison oak, dock, plantain and others. Care must be taken in its application, however, since it may kill clover and have an injurious effect upon grass.

Principal advantage of this product is its ability to penetrate quickly into the cell of the plant and to disperse to every part of the root system with a resultant quick death to the plant. Weed-No-More does not harm the soil, is non-poisonous to man and animals, is non-flammable and is not easily washed off by rain. It is to be marketed in concentrate form which must be diluted one fluid ounce to one gallon of water; a gallon of the mixture is sufficient to cover approximately 200 sq.ft. The manufacturer expects to have adequate stocks of this new material before it is placed on sale in the spring of 1946.

ARTIFICIAL LEATHER

AN IMPROVED simulated leather known as Terekan 12 which strongly resembles genuine leather in many respects including workability, eye-appeal, and flexibility, has been announced by the Athol Manufacturing Co., New York, N. Y. Designed originally to help correct a shortage of certain types of material such as cotton-base sheetings, Terekan 12 is said to be suitable for the manufacture of electric razor cases, portable radio and record player cases, silverware cases, linings for loose-leaf cover books, jewelry cases, books, picture frames, and for other applications where leatherlike materials are used.

Consisting essentially of a rope fiber base saturated with a synthetic latex, this material is coated with pyroxalin and has aging qualities and strength said to be superior to products treated with natural latex. Terekan 12 is available in 40-in. widths only, and has about the same thickness

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as light-weight sheepskin, from 0.012 to 0.015 in. It is produced in most colors except pure white and can also be made with a two-tone finish.

WET STRENGTH RESIN

ONE OF the leaders in the development of chemical compounds for imparting wet strength to paper, the Resinous Products and Chemical Co., Philadelphia, Pa. has recently announced a new material named Uformite 470, to be used for this purpose. Uformite 470 is said to be an entirely new type of urea-formaldehyde resin modification and requires no special handling, aging, or pre-treatment before use. After dilution with water it is ready for immediate addition to the stock prior to sheet formation. This resin is said to represent an advance over previous wet strength agents in that (1) it offers superior retention and wet strength development on sulphite, rag, and groundwood stocks; (2) it produces high wet strength with all stocks at low acidity; (3) it is effective with minimum quantities of alum or acid alone as catalyst, producing excellent durability of wet and dry strength.

In using this new material it is desirable to add it at such points as the headbox, screens or fan pump, since application prior to these points results in a definite sacrifice in wet strength development. Where it is used in the production of a sized sheet, Uformite 470 may be added either before or after the addition of the sizing material.

In the test work so far, this resin has been found particularly effective in producing high wet strength glassine, towelling, light-

weight absorbent tissues, sulphite wrapping papers, blueprint, map, chart, and ledger papers. It is also recommended for other types of stock including kraft, in which service the stock should be kept at a pH of 5.0 to 6.0. Either alum or acids may be used as catalysts although alum appears to be slightly more effective than acid alone at any given pH. In all cases, the pH of the stock at the head box should be 6.0 or below for best results, although Uformite 470 will generally show effective retention and high wet strength at high pH values.

In using this resin it is necessary to cure the paper from 10 to 21 days at room temperature to attain full wet strength. The properties of Uformite 470 are shown in the accompanying table:

Properties of Uformite 470

Solid content, percent	40
Solvent	Water-alcohol (2:1)
pH	7.5 to 8.0
Specific gravity	1.200 to 1.208
Weight, lb. per gal.	10
Appearance	water clear

INSULATING VARNISH

RECENTLY developed, by the John C. Dolph Co., Newark, N. J. a new type black flexible, oilproof, air-drying insulating varnish, Dolph's No. 238, is said to have many unusual qualities. This flexible, oil-proof finishing varnish is of a non-pigmented formulation, thereby preventing any settling out of color when stored for any period of time. It is extremely flexible, oilproof, and possesses a high wet and dry dielectric strength. The wet dielectric is about 600 v. per mil, and the dry dielectric over 1,500 v. per mil. Though not a baking varnish and not intended for coil impregnation, Dolph's No. 238 has many baking varnish qualities which are obtained after air drying for 6 hr. It has a slow initial set which provides easy application and aids in obtaining uniform coverage.

LUMINOUS PLASTIC

ACCORDING to a recent announcement by the Plastics Division of the Monsanto Chemical Co., Springfield, Mass., a new series of phosphorescent molding compounds are now available. Designated as the 1200 Lustron series, these polished molding materials are said to glow visibly for 6 or 8 hr. after exposure to sunlight or other illumination, in contrast to similar prewar materials which faded out after two or three hours.

Available in phosphorescent colors of green, green-blue, and blue these Lustron materials are expected to find use in switch plates, clocks, instrument dials, auto and aviation dashboards, light poles, street markers and door numbers. Price lists are available from the manufacturer. The same supply restrictions apply to these plastics as are in force on other thermo-plastic molding compounds.

EMULSIFIER

A NEUTRAL liquid emulsifier, Nonaethylene Glycol Mono Oleate S725 has been announced by the Glyco Products Co., Inc., 26 Court St., Brooklyn, N. Y. This new material is used to prepare DDT emulsions. The amount of DDT required to give the

desired concentration is dissolved in a suitable amount of a solvent such as xylol and about 10 percent of the liquid S725 is added. This DDT solvent concentrate is then added to the desired amount of water when and as needed, whereupon it forms excellent emulsions with little or no agitation. This material is now available in commercial quantities.

PORCELAIN ENAMEL

APPLICABLE in coats nearly as thin as used for the best organic paint finishes, Tite-Wite, a new porcelain enamel is now available from the O. Hommel Co., Pittsburgh, Pa. Tite-Wite is a super-opaque white cover coat in both regular and acid-resisting porcelain enamel, and is said to reduce markedly the chipping hazard previously present with regular porcelain enamel. This new material is expected to reduce production costs since it permits a thin application which practically eliminates chipping. Applications of 15 to 20 g. per sq.ft. are claimed to show reflectance readings of 75 to 80 percent. This non-chipping feature will permit more extensive and successful use of porcelain enamels on various products such as refrigerators, stoves, washing machines, kitchenware, etc.

COATING FOR WOOD

ANNOUNCEMENT of new material to coat the surface of plywood concrete forms has been made by the A. C. Horn Co., Long Island City, N. Y. Under the brand name of Formfilm, this material is useful in preparing forms such as plywood or other fibrous wood in which concrete will be held in proper position until setting takes place. Proper coating of the wood produces smooth concrete, free from grain markings and ready for painting. This material is said to effect a saving since only one coat is required, rather than two coats needed when other coating materials are used. It conditions the plywood, so that it is highly resistant to warping or swelling, and when dry it does not adhere to the concrete. It is claimed that forms treated with this material may be reused as often as four to five times without recoating. It is now available in commercial quantities.

CYCLOHEXANE DERIVATIVES

THREE new cyclohexane derivatives, epsilon-caprolactam, cyclohexanone oxime, and nitrocyclohexane have been announced by E. I. du Pont de Nemours and Co., Wilmington, Del. Epsilon-caprolactam is available either as a solid or as a 67.76 percent aqueous solution, and can be supplied in quantities from one pound lots for laboratory work to one ton lots for industrial applications. It can be hydrolyzed to give epsilon-aminocaproic acid which has been suggested as a starting material for the synthesis of alpha, epsilon-diaminocaproic acid, a nutrient and promoter for the growths of yeasts; it can also serve as an ingredient in the preparation of complex proteins and gels. Its vinyl derivative is said to have value as a textile assistant, plasticizer, etc. It may be chlorinated, sulfonated, methylated, etc. to produce various derivatives. Epsilon-caprolactam has a melting point of 68.5 deg. C., boiling point

of 136 to 138 deg. C., with a pH (40 percent aqueous solution) of 4.0 to 6.0. It is soluble in water, acetone, ethanol, benzene and chloroform. It is only slightly soluble in ether and in carbon tetrachloride.

Cyclohexanone oxime is a white crystalline solid and is available in quantities up to one ton. It is a ketoxime of cyclohexanone and is an important intermediate in organic reactions involving synthesis of cyclohexyl derivatives. Its properties are as follows:

Melting point, deg. C.	88.5
Boiling point at 760 mm. Hg, deg. C.	206-210
Boiling point at 10-12 mm. Hg, deg. C.	100-105
Vapor pressure at 43.5 deg. C., mm. Hg.	0.1
Purity, percent	99.9

Nitrocyclohexane is suggested as a solvent in the manufacture of rubber chemicals, resins, dyes, pharmaceuticals, and emulsions. It is available in lots up to 5 gal. for experimental purposes. It undergoes reactions typical of the nitroparaffins and can be hydrogenated at moderate temperature and pressure to form cyclohexylamine, and intermediates for use in the production of corrosion inhibitors, insecticides, solvents, and plasticizers. Its properties are as follows:

Boiling point at 760 mm. Hg, deg. C.	203-204
Boiling point at 40 mm. Hg, deg. C.	109
Boiling point at 20 mm. Hg, deg. C.	94
Freezing point, deg. C.	-34
Specific gravity	1.0630
Lb. per gal.	8.8
Flash point (open cup), deg. F.	180
Solubility in water at 25 deg. C., percent	0.15
Miscible with acetone, alcohol, benzene, cyclohexane, ether, and kerosene.	

CARBON 13

LIMITED availability of Carbon 13, a heavy carbon isotope, has been announced recently by the Sun Oil Co., Philadelphia, Pa. and the Houdry Process Corp., Wilmington, Del. Developed as an aid to biochemical research, Carbon 13 may be used in the study of metabolic disease processes occurring in diseases such as cancer, diabetes, hardening of the arteries, etc. Chemically the same as ordinary carbon, it undergoes the same metabolic processes. But, contrary to ordinary carbon, the isotope may be traced through various reactions with a mass spectrometer making it possible to conduct hitherto impossible investigations.

Since July 1945, the Houdry Process Corp. has been producing this material at the rate of about 1 gram per month. However, production of about 500 grams per month is being planned by the Sun Oil Co. It is expected that Carbon 13 will be made available without charge to qualified, non-commercial biological and medical research organizations whose activities and experience justify such donations.

VINYL COATING

DEVELOPED to fill the need for a one-coat material with good resistance to food acids and fats which will provide stability under high and repeated baking temperatures, Rolox Vinyl White has recently been announced by the Roxalin Flexible Finishes, Inc., Elizabeth, N. J. Because of its extremely high solids content only one coat of this new material is necessary to protect containers which must undergo process-



On this completely rebuilt heavy duty shaper at the Krautter-Weber Tool Works, the use of Veelos V-belt provided the following engineering advantages: 1. Eliminated overhead motor and overhead belt drive. 2. Provided better speed control...old drives had only one speed forward and return. 3. Ended noise and excessive vibration.

WHEN the Krautter-Weber Tool Works, Newark, N. J., decided to modernize this heavy duty shaper—built many years ago—it specified Veelos link V-belt on

four vital drives. Efficient speed control was a "must"—and, in selecting Veelos, Krautter-Weber chose the belt that helps hold machine speeds at desired rates *by providing uniform belt tension and by eliminating belt slippage:*

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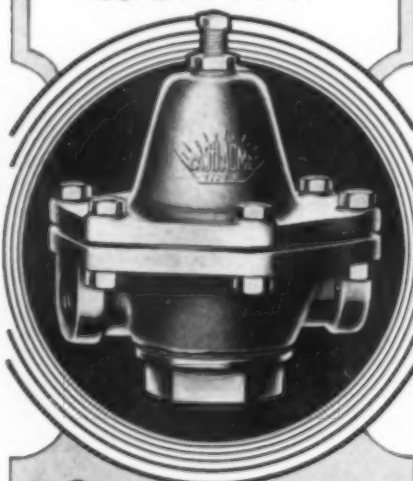
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sing such as pasteurization or sterilization. It is claimed to have good flexibility and will adhere even when it is applied directly to black plate, electrolytic or hot-dipped tin. It will not discolor under repeated baking and has successfully undergone tests in boiling water and under steam pressure. Its adaptability to food containers lies partly in the fact that it is odorless and tasteless.

BAKING ENAMEL

DEVELOPED to meet the need for faster production in all industries using organic finishes on metal, Porciflex was developed during the war by the H. V. Walker Co., Elizabeth, N. J. This new coating material with unusually fast-drying characteristics, when applied to metal is said to give a flexible porcelain-like finish having a high resistance to acid, alkali, oils and greases. In contrast to many materials that require baking at temperatures from 275 to 300 deg. F. for 30 to 60 min., Porciflex is baked at schedules from 1 min. at 450 deg. F. for sheet metal to 15 min. at 275 deg. F. for other types of work. It may be applied by spray, roller coating machine, or dip methods, and has wide adaptability due to its flexible make-up. It is claimed not to crack or flake and will not peel off under normal conditions. Porciflex is available in clear, black, white and other colors.

ANTI-MALARIAL DRUG

BELIEVED to be more effective than either quinine or atabrine, metachloridine (2-metanilamido-5-chloropyrimidine) has recently been developed at the laboratories of the American Cyanamid Co., Stamford, Conn. This new synthetic drug is now undergoing field tests, and is considered to be one of the most promising new anti-malarial drug. It appears to affect bacteria in a different manner from the various sulfa compounds now used rather extensively.

RODENTICIDE

DESIGNATED as "1080," a highly toxic and almost odorless poison, developed for the Fish and Wild Life Service at Bowie, Md., is one of the most lethal weapons for use against rats yet discovered. Although it is not commercially available yet, because it is lethal to humans, hard to detect and dangerous to use, the Monsanto Chemical Co., the sole manufacturers, have supplied it to government agencies. A number of cities have tested it and report on its high effectiveness. All kinds of rodents and other animal tests succumb to "1080." It is used in drinking water or bait. Strict government control has been recommended.

SUPERFINE FIBER GLASS

SMALL diameter Fiberglass with average diameters as small as $5/100,000$ ths of an inch will be made available for civilian consumption according to the Owens Corning Fiberglass Corp.; having the same basic properties as other Fiberglass materials, these downlike fibers of extremely light weight should find use as clothing inner liners, non-allergic bedding, and other similar uses. The heat insulating properties of the fiber provide a basis for their use as inner linings for such articles as comforters, sleeping bags, mittens, hunting jackets and other cold weather outdoor clothing.

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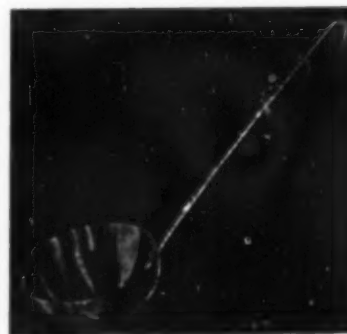
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CHEMICAL ENGINEERING NEWS

INDUSTRIAL ADVANCES TO BE ON VIEW AT CHEMICAL SHOW

MANY DETAILS of the important exploits of chemical engineering will be revealed at the 20th Exposition of Chemical Industries which will be held at Grand Central Palace, New York, from February 25 to March 2. The exhibits will occupy four floors in the Palace with many exhibitors cramped for space to display all they wish to place on view.

Chemical process equipment, which constitutes a large group of the exhibit material on the exposition program, reflects the many new processing requirements of the days ahead. In many instances there will be on view hitherto secret details of how a number of recent innovations were transferred from the laboratory to big-scale production. The general introduction of a single new product, whether it be a medication such as penicillin, a metal such as magnesium, or one of the newer plastics, requires the design and construction of one and sometimes several entirely new plants involving equipment much of which is entirely new and different from anything previously conceived.

It is in the new equipment items going into such plants that much of the interest in the exhibits lies. In such items as bacterial retentive filters, ceramic electrolysis diaphragms, rubber covered valves, centrifugals, agitators, emulsifiers, pulverizers, kettles, dryers and other units.

Another feature of interest includes X-ray diffraction apparatus for crystallographic studies of atomic structure and the composition of chemical compounds. Also a weather simulator which has been designed for the testing of products under weather conditions to be encountered in exporting to all parts of the world.

In the field of rare elements, exhibits will show new applications of zirconium compounds in rendering textiles water repellent and other zirconium compounds used in catalytic reactions. There also will be illustrations of the use of titanates in electronic applications which have been high on the secrecy list until now, and other titanium compounds used in welding.

VICTOR CHEMICAL WILL BUILD NEW PHOSPHORUS PLANT

EXPANSION of the elemental phosphorus-producing facilities of Victor Chemical Works was announced late last month by Walter B. Brown, executive vice president of the company. Site for a plant is being negotiated near the phosphate fields of western Florida and as soon as materials are available, construction will be started on an electrically controlled and operated furnace plant. Initial construction will involve an investment of over \$2,000,000 and long-range plans call for quadrupling the capacity for elemental phosphorus and products.

Building plans include an office building, employee change house and service building with medical facilities, chemical laboratory, machine shops, storehouse, boiler plant for process steam, a complete water system, and an emergency electrical generating plant. For power, the company will use steam produced by a private public utility.

DUPONT FORMS PETROLEUM CHEMICALS DIVISION

CONSOLIDATION of two divisions of the organic chemicals department into a single unit to be known as the petroleum chemicals division has been announced by E. I. du Pont de Nemours & Co. The merger combined the former alcohol and tetraethyl lead divisions operating plants at Deepwater, N. J., and Baton Rouge, La. The new division is headed by J. L. Stecher who had been manager of the tetraethyl lead division and the assistant manager is William F. Krug, Jr., formerly manager of the alcohol division. Other appointments include J. R. Sabina as technical director, Dr. J. M. Herndon, division production manager, and E. M. Fanning, assistant sales manager for petroleum chemicals. G. T. Barnhill, Jr., will remain as sales director for alcohol and camphor.

PACKAGING EXPOSITION IN ATLANTIC CITY IN APRIL

The Packaging Exposition of 1946 will be held in the Public Auditorium in Atlantic City, April 2-5. It will be sponsored by the American Management Association and is expected to be the largest in the 15 years history of the exposition with some 150 manufacturers of equipment, machinery, supplies and services essential to the field of packaging, participating.

Concurrently with the exposition, the American Management Association will hold a conference on packaging, packing and shipping, with authorities in the field addressing the technical sessions.

DCAT ELECTS OFFICERS FOR NEXT FISCAL YEAR

LAST month at the organization meeting of the new executive committee, the Drug, Chemical and Allied Trades Section of the New York Board of Trade, Inc., elected Harold M. Altshul, president of Ketchum & Co., Inc., as chairman. Other officers elected include Carle M. Bigelow, Calco Chemical Division, American Cyanamid Co., vice chairman; Robert B. Magnus, vice president, Magnus, Mabey & Reynard, Inc., treasurer; Helen L. Booth, New York Board of Trade, Inc., acting secretary. Carl M. Anderson, assistant to the president, Merck & Co., Inc., was re-appointed counsel. Guy L. Marsters, vice president of the Norwich Pharmacal Co., the retiring chairman, was presented with a gavel in recognition of his services during the past year.

SOLVAY OPENS NEW RESEARCH LABORATORY AT HOPEWELL

ON DECEMBER 14 The Solvay Process Co., nitrogen division, a subsidiary of Allied Chemical & Dye Corp., dedicated a new industrial chemicals research laboratory in the Highland Park section of Hopewell, Va. Dr. C. K. Lawrence will be director of the laboratory where work will be conducted on a bench scale. Promising developments will be subjected to further research and study in pilot or intermediate scale test plants at the company's chemical manufacturing installations in Hopewell.

Opening of the new laboratory centralizes the nitrogen division's development department work and involves the transfer of a number of research workers from Syracuse. This group and its processors developed a process for fixation of nitrogen from the air and in 1921 built at Syracuse the first successful synthetic ammonia plant in America. In 1927 the group constructed a larger plant at Hopewell for the production of ammonia and sodium nitrate. Expansions at Hopewell include installation of a salt process chlorine plant and facilities for producing nitrogen fertilizer solutions and a high nitrogen-content solid fertilizer. Some of the more recent developments regarded as promising include a new synthetic detergent, anhydrides of alkenyl succinic acids, and nitrogen tetroxide and nitrosyl chloride.

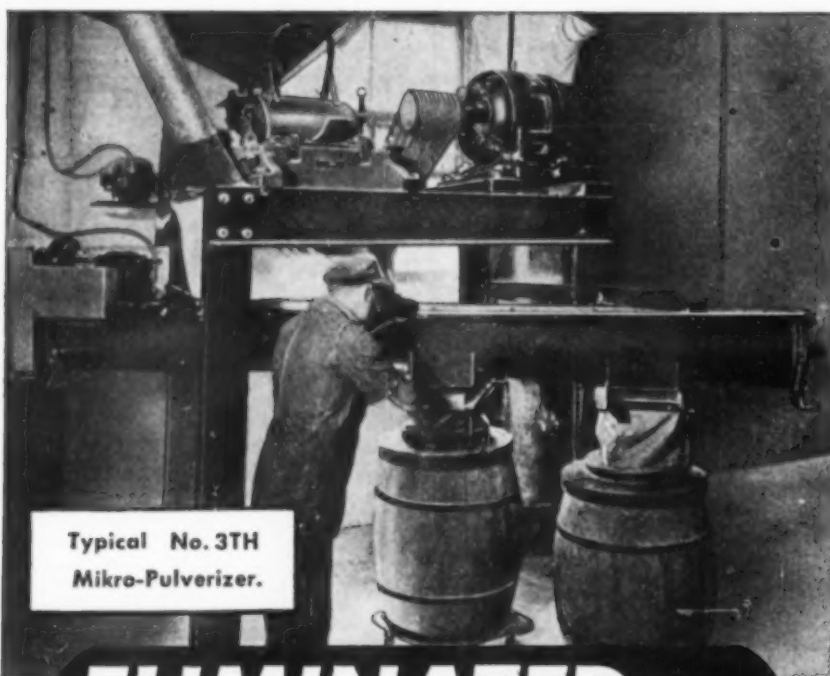
NAVY OPENS RESEARCH OFFICE AT NEW YORK

A NEW YORK headquarters for the Navy's Office of Research and Invention has been opened at 1 Park Ave. Rear Admiral H. G. Bowen, chief of this branch, said many scientists of the New York area presently returning to peacetime pursuits were actively engaged in Navy research during the war and it was desired to hold their interest in naval problems during peace. Commander Duane L. Wallick, USNR, officer-in-charge of the Special Devices Depot to date, will be in charge of the new office. The New York branch will be an activity of the 3rd Naval District and will include functions of the Patents Division and of the Special Devices Depot.

SPECIALISTS FROM INDUSTRY TO LECTURE AT BROOKLYN

A GROUP of 13 specialists from industry will participate in the graduate seminar dealing with the economic and cost aspects of chemical industries which will be offered by the Polytechnic Institute of Brooklyn beginning February 8. Under the auspices of the Department of Chemical Engineering, the course will be directed by Robert S. Aries, consulting engineer and research associate at the Polytechnic Institute.

The 13 specialists who will lecture during the course include: L. W. Bass, director of



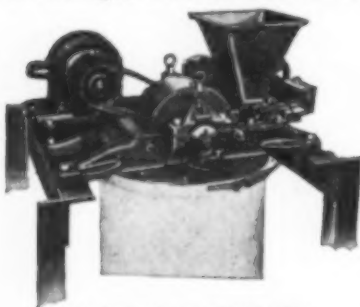
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research, U. S. Industrial Chemicals, Inc.; Charles O. Brown, consulting engineer; W. H. Carrier, chairman of the board, Carrier Corp.; Gustavus J. Esselen, consulting engineer; Paul L. Gomory, patent attorney, Sun Oil Co.; Willard H. Dow, president, Dow Chemical Co.; John W. Happel, chief project engineer, Socony Vacuum Oil; Williams Haynes chemical economist; Walter J. Murphy, editor, *Industrial and Engineering Chemistry*; J. G. Park, vice president, Standard Alcohol Co.; Walter von Pechmann, works manager, Ansco Division, General Aniline and Film Corp.; John M. Weiss, consulting engineer; and R. B. Wittenberg, manager, chemicals department, International Minerals and Chemical Corp.

QUALITY CONTROL SOCIETY ORGANIZED AT PITTSBURGH

LAST October, an organizing committee for a national quality control society met at Pittsburgh and established the Society for Quality Control. Since then the executive committee has taken steps to make this a permanent organization. The organizing committee felt that all the problems connected with the establishment of such a society could not be settled at one meeting and decided to set up an interim organization to serve for not more than one year. Edward M. Schrock was elected president and Ralph E. Wareham, secretary-treasurer.

The general intent of the society is to serve all who are interested in quality control giving particular attention to those engaged in manufacture and inspection. Also it is planned to publish material that will be of help to quality control people everywhere. Local societies at Boston and Wilmington have formally expressed their desire to join the national organization, thus increasing the number of chapters to 14. Several other local societies have not yet taken official action.

NEW COUNCILORS-AT-LARGE ELECTED TO ACS COUNCIL

FOUR leaders in chemistry and chemical engineering have been elected councilors-at-large and will serve three-year terms on the council which is the advisory body on policy and general management for the American Chemical Society. The new councilors are Dr. Robert E. Wilson, chairman of the board of the Standard Oil Co. of Indiana; Dr. Lawrence W. Bass, director of research and development of United States Industrial Chemicals, Inc.; Dr. Ralph L. Shriner, chairman of the chemistry department of the University of Indiana; and Dr. Hobart W. Willard, professor of chemistry at the University of Michigan.

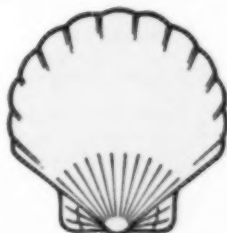
CHEMICAL RESEARCH GROUP MEETS IN CLEVELAND

THE SECOND regular meeting of the Chemical Market Research Association was held at the Hotel Cleveland, Cleveland, Ohio, on December 13. J. G. Park, vice-president of Standard Oil Co. and president of the association opened the luncheon session and introduced the general theme for the meeting which was about the future of the chem-

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ical industries. Guest speaker was John Love of the Cleveland Press who discussed the chemical industry in the Cleveland area.

At the afternoon session Dr. R. F. Ruthruff, research director of the Sherwin-Williams Co. spoke on the future need for chemicals in producing protective coatings. Merle J. DeFrance of Goodyear Tire & Rubber Co. took up the question of chemical needs as referred to the rubber industry. S. L. Brous of B. F. Goodrich Chemical Co. carried on the general theme from the standpoint of the plastics manufacturer. At the dinner session, Dr. Carl F. Prutton, head of the department of chemistry and chemical engineering, Case School of Applied Science, gave an address on "Chemical Futures."

CHICAGO CHEMICAL SHOW TO BE HELD IN SEPTEMBER

THE DATE of the National Chemical Exposition, which will be held in the Coliseum, Chicago, under the sponsorship of the Chicago Section of the American Chemical Society, has been moved forward to September 10-14. Marcus W. Hinson who has managed these expositions since their inception in 1940 will again be exposition manager. Dr. H. E. Robinson, assistant chief chemist

CONVENTION CALENDAR

American Society for Metals, annual convention, Statler Hotel, Cleveland, Ohio, February 4-8.

The Society of the Plastics Industry, Canadian Section, fourth annual conference, General Brock Hotel, Niagara Falls, Ont., Canada, February 6-7.

Technical Association of the Pulp and Paper Industry, annual meeting, Hotel Commodore, New York, N. Y., February 24-30.

Exposition of Chemical Industries, 20th exposition, Grand Central Palace, New York, N. Y., February 25-March 2.

American Institute of Chemical Engineers, regional meeting, Hotel Biltmore, New York, N. Y., February 26-27.

Midwest Power Conference, annual meeting, Palmer House, Chicago, Ill., April 3-5.

The Electrochemical Society, Inc., national meeting, Tutwiler Hotel, Birmingham, Ala., April 10-13.

First National Exposition of the Plastics Industry, sponsored by The Society of the Plastics Industry, Grand Central Palace, New York, N. Y., April 22-27.

American Ceramic Society, 48th annual meeting, Hotel Statler, Buffalo, N. Y., April 28-May 1.

National Association of Corrosion Engineers, annual meeting, President Hotel, Kansas City, Mo., May 7-9.

Society for the Promotion of Engineering Education, 53rd annual meeting, Jefferson Hotel, St. Louis, Mo., June 20-23.

Fourth National Chemical Exposition, Chicago, Ill., September 10-14.

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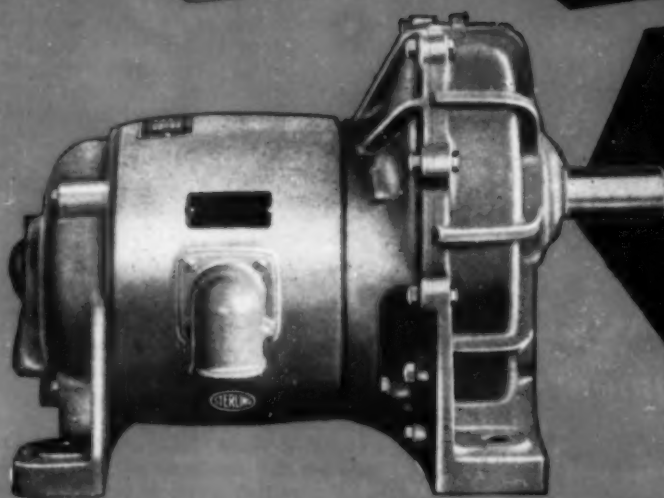
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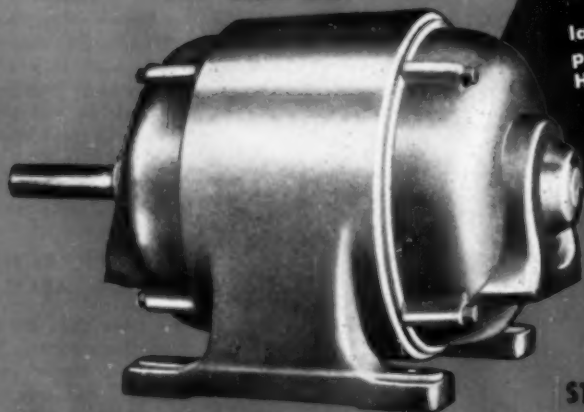


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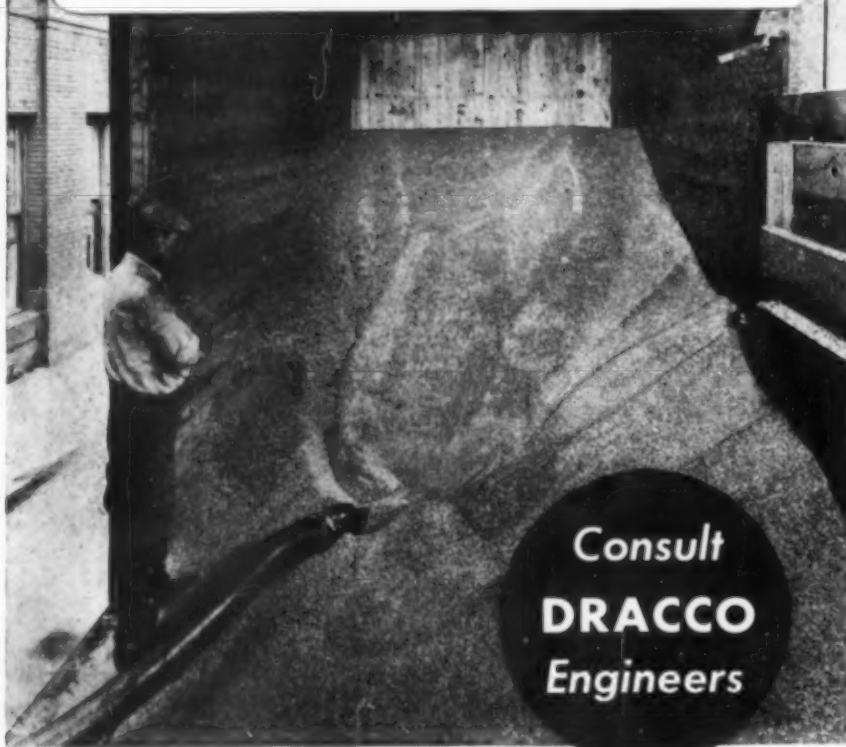
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of Swift & Co., is chairman of the exposition committee.

Associated with Dr. Robinson on the committee are S. M. Cantor, assistant director of research of Corn Products Refining Co.; R. N. DuPuis, assistant director of Miner Laboratories; R. F. Marschner, group leader in research department of Standard Oil Co. (Ind.); B. N. Rockwood, research chemist, Swift & Co.; E. H. Schaar, assistant to the president of Schaar & Co.; A. E. Schneider, research chemist, Armour & Co.; J. K. Stewart, technical advisor, Sherwin-Williams Co.; Lyle O. Hill, partner, Riverdale Chemical Co.; R. K. Summerbell, chairman of the department of chemistry, Northwestern University; and W. M. Urbain, head of physics and physical chemistry division, research laboratory, Swift & Co.

DU PONT WILL CONSTRUCT NEW PLANT FOR FORMALDEHYDE

ANNOUNCEMENT was made last month that E. I. du Pont de Nemours & Co. will start construction in the spring on an addition to its plant in Toledo, Ohio, and that the new unit will be used for the manufacture of formaldehyde. Production will be under the control of the Electrochemicals Department of the company. The new unit will be built on the property of the Gracelli Chemicals Department plant at Stickney and Matzinger Roads. Estimated cost is \$1,000,000.

INTERNATIONAL MINERALS BUYS PHOSPHATE LANDS

NEGOTIATIONS have been completed for the purchase by International Minerals & Chemical Corp. of a phosphate rock deposit near Bartow, Florida. The property consists of about 2,000 acres and will be used for the development of a phosphate mine operation which is expected to have a life of more than 25 years and to yield the greatest annual tonnage of high-grade phosphate rock ever mined from a single operation. The rock will be shipped from Bartow by rail to Mulberry, Fla., present center of the corporation's phosphate mining activities in that state, where it will be dried, graded, stored and distributed to manufacturing outlets.

COURSE ON MANAGEMENT OF RESEARCH

LAST year, the graduate division, College of Engineering, New York University, offered a course on the management of research and development. The course was established to take care of the needs of industry for men who had training in this field. It will be repeated this year beginning January 31. The registration period is January 21-24. Lectures in the course will be given by a group of directors of research of leading companies.

LEONARD REFINERIES WILL USE THERMOFOR UNIT

CONTRACTS have been executed between the Houdry Process Corp., Wilmington, Del. and Leonard Refineries, Inc., Alma, Mich., whereby Leonard will acquire a Thermoform catalytic cracking unit. It is the

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first small scale unit to be built with private capital to operate for postwar motor gasoline.

The small integral TCC unit has been designed by Houdry engineers to process 3,000 bbl. per day of charge stock. While the unit embodies a number of design simplifications, it is in principal very similar to the larger TCC units.

INDUSTRIAL RAYON MOVES EXECUTIVE OFFICES

IN ORDER to provide additional space for the company's engineering and mechanical development staffs, Industrial Rayon Corp. has transferred its executive offices from the company's general office building at the Cleveland plant to the Union Commerce Bldg. The engineering and development staffs have been augmented to handle the planning of a new plant which the company has announced and for special work as a result of the sale of patent rights to its continuous process in foreign countries.

SHELL OIL INCORPORATES CHEMICAL DIVISION

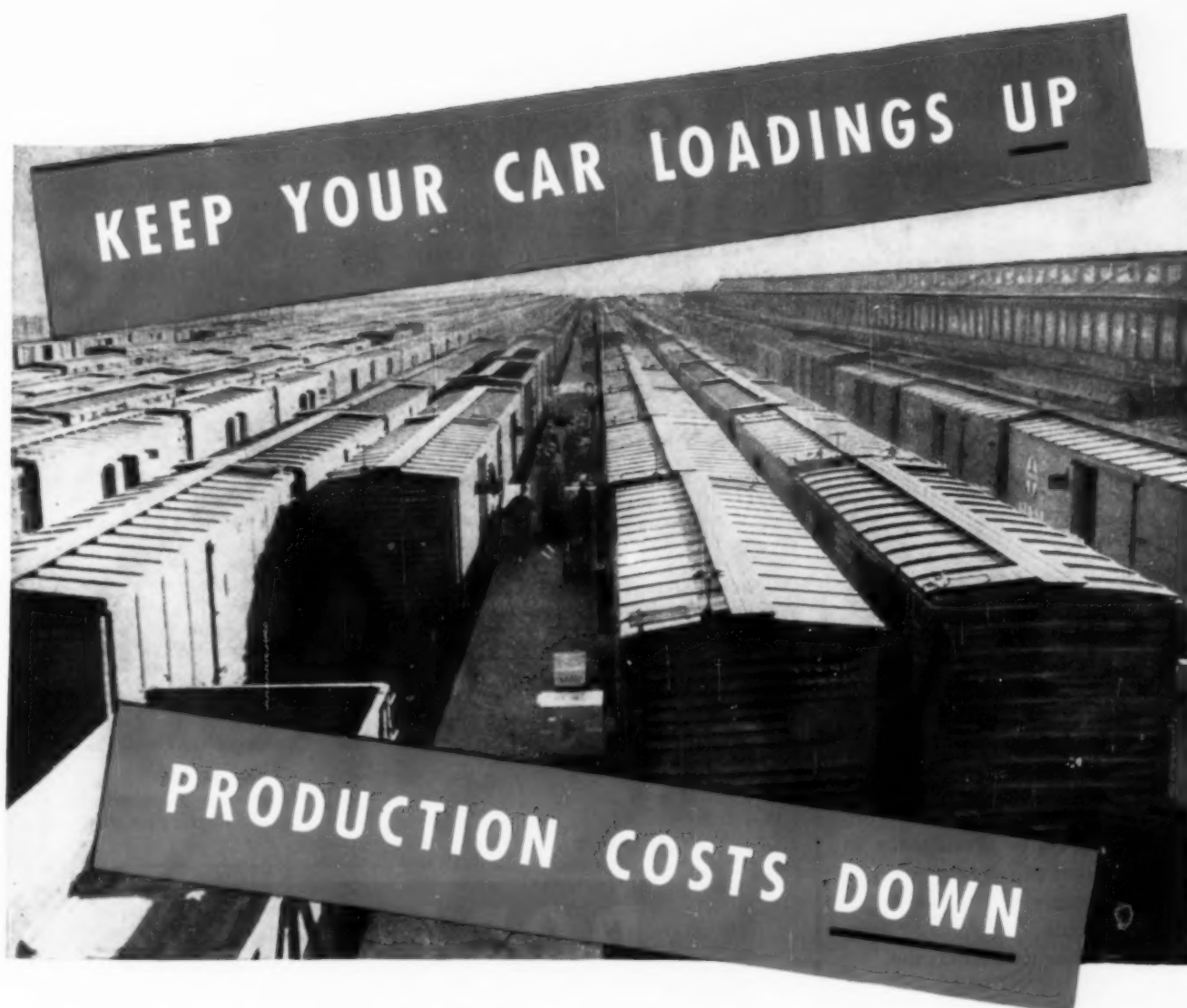
IN WHAT is described as a preparation for a large expansion program, the Shell Chemical Corp. has been incorporated in Delaware to take over and continue the business of the chemical division of Shell Union Oil Corp. The new corporation will be a wholly-owned subsidiary of Shell Oil Co., Inc. and its main office will be located in the Shell Bldg., San Francisco, with a New York office maintained at 500 Fifth Ave. It will continue operation of the three plants in California at Shell Point, Martinez, and Dominguez and later will take over operation of the company's chemical plant at Houston, Tex. It also will operate the butadiene plant at Torrance, Calif., for the Office of Rubber Reserve.

Officers of the new corporation are J. Oostermeyer, president; W. P. Gage, and L. V. Steck, vice presidents; J. W. Watson, treasurer; J. Rysdorp, secretary; P. T. Vockel, assistant treasurer; and J. M. Selden, assistant secretary.

DUPONT WILL ENHANCE THE IMPORTANCE OF RESEARCH

A NEW series of research positions designed to make science as a career as attractive as the administrative field in industry has been announced by the technical division of the rayon department of E. I. du Pont de Nemours & Co. The announcement stated that if there were an obvious progressive path for men whose natural bent is for scientific work rather than administrative, these men would elect this path rather than aspire to become supervisors. Hence the company has adopted a plan which provides three classifications of research associates with salary rates corresponding to those for supervisors, managers, and assistant research directors.

The new classifications are specified by the titles of junior research associate, research associate, and senior research associate. Dr. E. B. Bengner, manager of the technical division, has named three members of his staff to the new positions. Dr. W. E. Roseveare, research supervisor in charge of the basic research group of the viscose rayon



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research section at the Spruance plant in Richmond, and Dr. E. F. Izard, pioneering research section at the Yerkes plant in Buf-

falo, were appointed research associates. Dr. E. V. Lewis of the nylon research section was appointed junior research associate.

READERS' VIEWS AND COMMENTS

VETERAN RECOGNITION

To the Editor of Chem. & Met.

Sir:—I read with great interest the article "Recognize Veterans for What They're Worth" by Ernest W. Fair in the November issue of *Chemical and Metallurgical Engineering*. Sergeant Fair has written a timely article on a subject vital to the veteran and educational to the employer.

The sergeant's reasoning is sound and logical. It gives the employer information too often brushed aside by the busy personnel agents or entirely ignored in many employer-employee contacts.

It is by means of the MOS numbers that an employer has an opportunity to evaluate the applicant's knowledge acquired in the service. A veteran, however, has learned many things that can not be adequately described on paper. He has learned to live with people, to make acquaintances quickly and easily, to assume responsibilities, and to reach logical and effective conclusions in a minimum length of time. Service life is indeed educational in every sense of the word.

Soldiers, sailors, marines, and coastguardsmen are returning with the fervent hope that their new life will be better than the one they left to enter the fighting forces. They expect to work hard to make this hope a fact. What they ask is the opportunity to

put their qualifications into action. Here's hoping that employers take Sergeant Fair's message to heart and really "Recognize Veterans for What They're Worth."

INTERESTED VETERAN

SCIENCE vs. POLITICS

To the Editor of Chem. & Met.

Sir:—I have read with interest the extract from your address accepting the Chemical Industry Medal (November, p. 101), which leads me to the following observation, including a new word I have coined:

Politicians have now entered a new field of ignorance. Their discussions of the atomic bomb, what should be done with it, and how it can be used as a threat to other countries, have introduced a new era of loud talk and political gestures. We may well call this new enterprise "Polatomics," in which the ignorant are trying to play politics with the most dangerous instrument the world has ever known.

DANIEL BLOOMFIELD

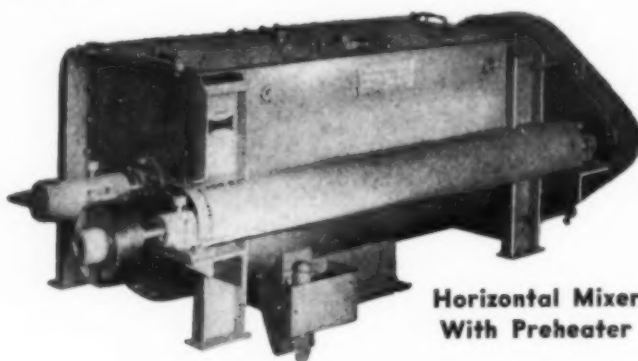
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We hope this doesn't add to the "confession" of issues that characterizes so much of Washington's thinking on atomic energy.
—Editor.

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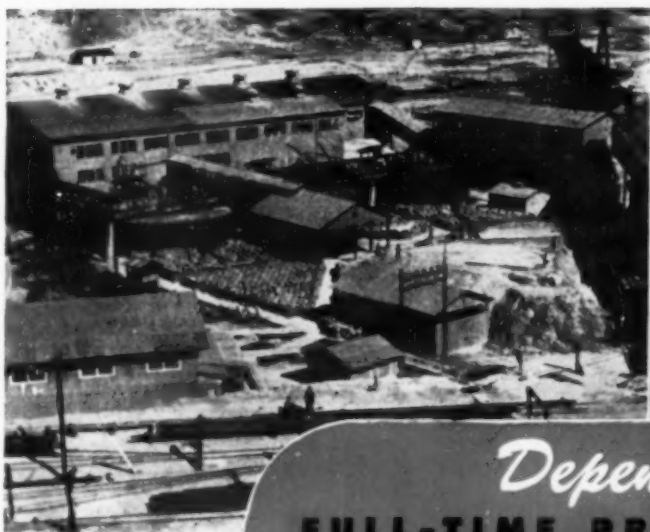
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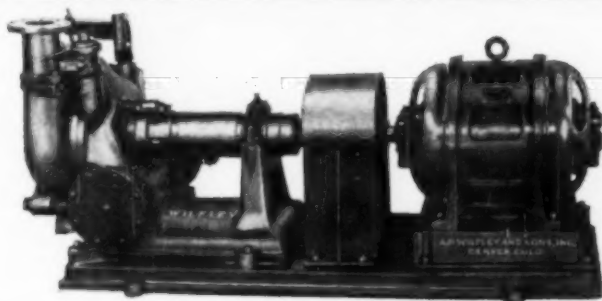


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TRENDS • EVENTS • DEVELOPMENTS

JOHN R. CALLAHAM, Pacific Coast Editor, San Francisco, Calif.

LAS VEGAS TO BE CHEMICAL CENTER OF NEVADA

WHAT may become a valuable chemical production area for the West and the leading chemical center of Nevada seems to be rapidly taking shape at Henderson under the leadership of J. M. Montgomery Co., engineering firm of Los Angeles that holds the former Basic Magnesium plant under an agreement with DPC, and of Stauffer Chemical Co., San Francisco. For a number of months Stauffer Chemical Co. has been operating under lease approximately half the Hooker S cells of the two chlorine-caustic units of Basic Magnesium, the remaining cells being used for supplemental maintenance only.

Success of the two firms in interesting other chemical producers to locate at BMI is shown by the recent announcement that Amecco Chemicals, Inc., has signed a long-term lease for the No. 2 magnesium metal unit to produce an extensive list of secondary and tertiary organic products from chlorinated hydrocarbons. Amecco will use chlorine provided by Stauffer and anhydrous aluminum chloride to be produced in the BMI cell feed preparation unit leased by New York-Ohio Chemical Co., an affiliate of Stauffer Chemical Co. and Harshaw Chemical Co. The synthetic organic chemicals made by Amecco will be produced with the West Coast market in mind but will have national distribution as well. M. G. Masten is now manager of Amecco activities, while Paul Bralier is manager of Stauffer operations.

Western Electrochemical Co. of Los Angeles, which had arranged to produce perchlorates for the government when the war's end halted the plan, is negotiating a contract with RFC for lease of facilities to produce potassium chlorate and perchlorate by the firm's electrolytic process. Fred Gibson is manager of the Western Electrochemical operations.

In addition, Stuart Oxygen Co., San Francisco, is reported to be interested in the location as a plant site. Thus the chemical products that are now being produced or which will most likely soon be in production at the BMI plant include chlorine, caustic soda, anhydrous hydrochloric acid, aluminum chloride, hydrogen, potassium chlorate and perchlorate, primary chlorinated hydrocarbons as well as secondary and tertiary organic derivatives of these. In addition, other chemicals may also soon be offered to West Coast industries.

Incentives for chemical firms to locate at the former magnesium plant include the availability of modern plants and facilities, large amounts of chlorine and caustic soda, abundant low-cost power, low-cost housing and a good supply of processing water. In a recent conference arranged by H. H. Gillings, general manager for J. M. Montgomery Co., representatives of the above

firms were assured by governor Vail Pittman that ample and even cheaper power would continue to be available to the firms after the State of Nevada started withdrawing power three years hence under the terms of the Boulder Canyon Project Adjustment Act. A special committee under G. P. Frazer, executive assistant to Mr. Gillings, was appointed to start a vigorous campaign for equitable, competitive freight rates. This group will go into action immediately. Another committee, consisting of state labor officials, was appointed to expedite all dealings with the RFC.

GAS DEHYDRATION WORK IN PROGRESS

IN AN effort to improve the efficiency of high-pressure transmission of natural gas, the Engineering Experiment Station of the University of Colorado, Boulder, is conducting large-scale experimental studies for the Stearns-Roger Manufacturing Co., Denver. The research project also aims to develop improved methods for removing water vapor from natural gas to prevent freezing and erratic flow. Research engineers under Dr. J. E. Stepanek, assistant professor of chemical engineering, are now assembling reaction towers and other equipment.

PHTHALIC ANHYDRIDE UNIT APPROACHES CAPACITY

PRODUCTION at the new \$1,000,000 phthalic anhydride unit of Oronite Chemical Co. at Richmond, Calif., is now moving steadily toward full capacity, according to a recent announcement by Standard Oil of California, the parent firm. Capacity of

the new plant, the only one producing this chemical west of the Mississippi River, had previously been given at 3,500-4,000 tons annually. Initial operations began during August. The Oronite plant is the only one in the world producing phthalic anhydride from petroleum-derived ortho-xylol; all other plants use naphthalene obtained from coal tar.

Production of this basic chemical raw material will aid greatly in integrating the organic chemical industries of the west; capacity operation of the plant would give this area about 6 percent of the nation's present total production of phthalic anhydride. Present largest markets for the chemical are in alkyd resins for paints and adhesives, plasticizers for plastics and synthetic rubber, insecticides, dyes, and in organic synthesis.

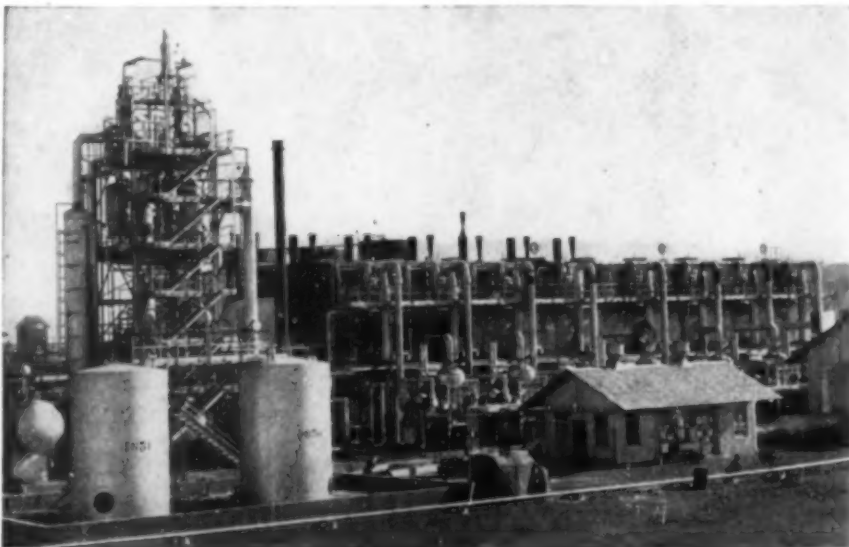
PLANS FOR CLAY-COATED PAPER MILL PROGRESS

PLANS to convert in part from production of newsprint to clay-coated book and magazine paper are taking shape at the Crown Willamette paper mill at West Linn, Ore., with construction of a coating preparation plant and erection of a 75-ton bleach plant scheduled for the near future. The new mill is being designed to round out a major development program that will meet contracts of the Crown Zellerbach Corp. with large national magazines for up to 60,000 tons of coated paper annually.

AGRICULTURAL GYPSUM COMES FROM WYOMING

RECENTLY organized to exploit an unusual 90,000,000-ton deposit of high-sulphur gypsum near Thermopolis, Wyo., the Sulphur Springs Gypsum Co. is already shipping its products to agriculturists, according to H. J. Adams, vice president and general manager of the firm. With orders for more than 50,000 tons annually outside the states of Wyoming and Montana already on file, the firm plans to spend close to \$100,000

First plant west of the Mississippi river to produce phthalic anhydride is this unit of Oronite Chemical Co. at Richmond, Calif. Now nearing capacity operations, the plant is the first in the world to use a petroleum raw material





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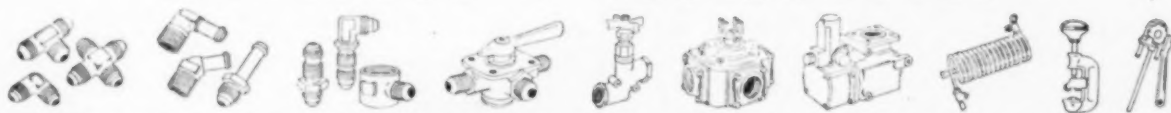
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to improve the properties and to build a plant for turning out 200 tons of the material per 8-hr. shift. The deposit, said to analyze 14 percent CaO and 30 percent free sulphur, was laid down by a large hot spring. Use of sulphur-containing gypsum on certain soils in the Northwest states is being strongly advocated by the U. S. Department of Agriculture. President of the Sulphur Springs Gypsum Co., which has headquarters at Thermopolis and a sales office at Billings, is Glen A. Richardson.

PUGET SOUND ALCOHOL NOW GOES TO INDUSTRY

GOVERNMENT purchase of alcohol produced from waste sulphite liquors in the Puget Sound Pulp & Timber Co. plant at Bellingham, Wash., has been discontinued since September. However, the company reports that the remainder of its year's output has been sold to a major industrial alcohol consumer concern. Production of alcohol for the third quarter was reported at 360,730 gal. Original design capacity of the plant, which began operations early this year, was 2,100,000 gal. annually.

It was announced that the company shows a 1945 net profit thus far of \$326,585 as against a like period in 1944 of \$349,101. Total income, however, includes a non-recurring net capital gain of \$193,094 for this year and of \$509,067 for 1944, both of which were payments received for sale of Canadian timber properties.

SOUTHERN CALIFORNIA ACS PUBLISHES SCALACS

BEGINNING in October, the Southern California Section of the American Chemical Society, Los Angeles and vicinity, has issued a monthly publication entitled *Scalaes* which is devoted to Society affairs of the region. This becomes the second such ACS local section periodical for the west although the Oregon and Sacramento sections issue regular mimeographed news letters. Editorial material consists of news items, announcement of forthcoming meetings, employment opportunities, abstracts of meeting papers, and ACS member activities. George M. Cunningham of Pasadena is editor, while A. N. Prater, G. R. Robertson and A. O. Beckman are associate editors.

MATERIALS RESEARCH CENTER PLANNED BY PABCO

GROUND will soon be broken at Emeryville, Calif., on the large research expansion program recently announced by R. H. Shainwald, executive vice president of Paraffine Cos., Inc., San Francisco. Estimated to cost possibly \$1,500,000 the expansion is said to provide the West with the most modern and complete building materials research center west of the Atlantic Seaboard and with one of the larger industrial research laboratories in the nation. The expanded facilities will be devoted to research on developing better and less expensive building materials and in constantly improving the present Pabco line of paints, roofings and linoleums. Design and construction of the laboratory expansion will be supervised by L. S. Rosener of San Francisco.

These additional research facilities will add considerably to the cost of the previously

HOW TO TRAP A LOW PRESSURE HEATING SYSTEM

... for
Lower Costs

and Greater Efficiency

Reduces Trap Maintenance 50%; Heats Up Buildings 50% Faster; Reduces Coal Consumption 5 Tons Per Day.

Many trap users have found by experience that maintenance costs for so-called low pressure traps on easy heating service were GREATER than for Armstrong Traps on heavy duty high pressure service. Furthermore, records have shown that the extra maintenance costs more than made up for any saving in first cost. It is not surprising, therefore, that these buyers have standardized on Armstrong Traps for all services, with these typical results: Defender Photo Supply Co., Rochester, N.Y., put 300 Armstrong Traps on unit heaters, fin coils, etc., and found trap maintenance reduced about 50% . . . New York Military Academy heats up buildings 50% faster in the morning with Armstrongs . . . Springfield, Ohio, high school reduced coal consumption from 9 tons to 4 tons daily . . . Atlanta building reports: "Not one cent for trap maintenance in 10 years."

It pays to buy quality. Armstrong traps don't leak steam; they have adequate automatic air handling capacity; they'll last a long time because of chrome steel valve and seat (ground, hardened and lapped) and stainless steel bucket and valve lever assembly. Nothing to stick, clog or collapse. For any pressure, any vacuum. Write for a survey of your plant today. ARMSTRONG MACHINE WORKS, 858 Maple St., Three Rivers, Michigan.

One of a series of advertisements, each discussing trapping practice on a different class of equipment.



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Inverted Bucket

STEAM TRAPS

Over a Million in Use... For Power... Process... Heating



The **CLARK FLEET** ... is revolutionizing material handling

There's a machine for every need — Clark team of Fork Trucks and Industrial Tractors. Each is a fast, maneuverable, hard worker designed specifically to meet the practical working needs of a particular Material Handling job.

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METAL SPOKE WHEELS • GEARS AND FORGINGS • RAILWAY TRUCKS

announced \$4,500,000 factory expansion by Paraffine. Construction of the first units of the expanded paint, roofing, linoleum and floor covering manufacturing departments at Emeryville, for which detailed planning was started in April 1944, is now under way. Most of the products from Pabco's 1,600-man Emeryville plant are marketed east of the Mississippi River.

CALIFORNIA CHEMICAL EARNINGS UP

AVERAGE straight time hourly earnings of wage earners in the chemical manufacturing industry of California increased from \$0.75 in January 1940 to \$1.08 in August 1945, according to data computed by the research department of the California State Chamber of Commerce, San Francisco. This represents an increase of 44.0 percent in straight time hourly earnings as compared to the wage earners' average increase in cost of living in principal California communities of about 31 percent since 1939.

STANDARD OIL TO RUN GOVERNMENT REFINERY

ENTERING into a contract with Reconstruction Finance Corp., Standard Oil Co. of California has agreed to operate under lease most of the huge \$20,600,000 government-owned 100-octane refinery at Richmond, Calif. The plant, one of the largest war producers of high-octane aviation fuel, will manufacture premium quality motor gasoline. Requiring approximately 150 skilled workers, the refinery has a designed daily capacity of 8,000 bbl., of 100-octane gasoline, but under war stress this output was upped to 12,000 bbl. Production of motor gasoline will probably approximate 8,000 bbl. daily.

MONTANA PHOSPHATE ROCK OUTPUT INCREASES

AFTER considerable exploratory and development work, International Minerals & Chemical Corp. has now completed remodeling its phosphate rock mill and plans to operate on a basis of 800 tons daily. Operations will be based on beneficiation, drying and grinding operations proved in pilot plant work during 1944 and early this year. This firm's new phosphate mine is located at Sherryl, near Drummond, Mont. It is understood that flotation concentrates will be shipped to Trail, B. C., and to the Hawaiian Islands for fertilizer purposes.

CEMENT MILL EXPANDS UTAH OPERATIONS

BELIEVING that the Salt Lake Valley area promises a considerable industrial and agricultural development in the future, the Ideal Cement Co., Denver, Colo., has announced plans for expanding and rehabilitating the facilities of its cement plant at Devil's Slide, Utah. Increased storage and shipping facilities to cost, including machinery and equipment, more than \$300,000 are now about 25 percent installed. It is hoped that the work will be completed by May 1946. In addition to these facilities, a complete rehabilitation of the entire plant, probably a department at a time, is planned as rapidly as conditions will permit. The announced objective is to increase flexibility of opera-



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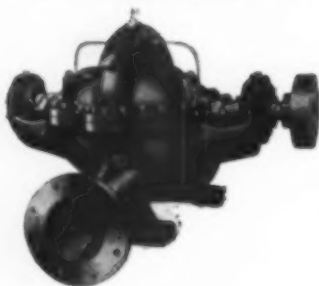
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Continuous Duty HORIZONTAL PUMPS Precision-built by PEERLESS



Peerless (formerly Dayton-Dowd) Horizontal Centrifugal split case or solid volute pumps, single and multi-stage are found wherever reliability, dependability and economical operating costs are desired. Engineered and manufactured with a view to long life. Peerless Pumps are available for all classes of pumping requirements.



HORIZONTAL PUMPS FOR:

Water Towers, Boosters, Fire Protection, Boiler Feed, Condensate, Sewage and Chemicals.

VERTICAL PUMP TYPES:

Deep Well Turbine, Hi-Lift Moyno Type), Centrifugal, Sewage, Jet, Shallow Well and Hydro-Foil (propeller).

The right pump for the right job. All inquiries and specifications processed by trained engineers.

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PUMP DIVISION

Food Machinery Corporation

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tions so as to permit servicing all types of construction jobs promptly with cements meeting the more stringent specifications developed within recent years. The firm's quarry at Devil's Slide is located in practically an inexhaustible supply of limestone.

CHEMICAL PLANTS LITTLE AFFECTED BY WAR'S END

As of November 1, the chemical industries of California were relatively little affected by the war's end, according to statistics on manufacturing employment compiled by the California Division of Labor Statistics & Research. Employment in chemical and allied products manufacturing dropped from 17,700 in July to 15,200 in October, a loss of 14 percent. During almost the same period (July through September) the comparable figure for the entire United States was 25 percent, according to figures from the U. S. Bureau of Labor Statistics. Practically all the loss in the state employment was in the Los Angeles area, which declined from 8,200 to 5,900 while the San Francisco Bay area declined from 6,100 to 5,700. However, the Los Angeles area has had a much more rapid growth in chemical employment in recent years. These areas combined account for about 75 percent of all chemical employment in California.

The state's chemical workers amounted to 3.4 percent of all such workers in the country during 1939 and 3.3 percent during September 1945. Although it may be too early to draw reliable conclusions, it does appear that California's relative position in this industry, as measured by production workers, will be determined more by what it can retain than by what it has gained during the war years.

Employment in Chemical and Allied Products Manufacturing in California*

Year	California	Los Angeles	San Francisco
1935	9,700	3,100	5,000
1936	10,100	3,300	5,000
1937	10,800	3,600	5,200
1938	9,900	3,300	4,700
1939	9,900	3,200	4,800
1940	10,200	3,200	5,000
1941	11,500	3,800	5,600
1942	13,400	4,400	6,200
1943	15,300	5,900	5,800
1944	17,200	7,400	6,100
1945	18,800	8,000	5,900
Jan.	19,100	8,300	6,000
Feb.	18,000	8,100	6,100
March	17,900	8,000	6,200
April	17,500	8,000	5,900
May	17,400	7,900	6,000
June	17,700	8,200	6,100
July	17,200	8,000	5,900
August	14,600	5,800	5,500
Sept.	15,200	5,900	5,700
Oct.			

* From the California Division of Labor Statistics and Research, San Francisco. Includes production and related workers only. Industries covered are paints, varnishes and colors, industrial chemicals and miscellaneous chemical products.

SUPERCYCLOTRON BUILT FOR ATOMIC RESEARCH

When University of California scientists complete their 184-in. supercyclotron next summer they will enter an era of atom smashing which will overshadow in many ways the research that led to development of the atomic bomb. The new 4,000-ton machine will eventually produce deuterons of 200 million electron volts and protons and alpha particles of 400 million electron volts. These energies are almost 10 times

CASE HISTORY No. 1
No. 1 in a series of factual experiences of a group of American manufacturers with Multiwall Paper Bags.

COST COMPARISON

	200 lb. Barrels	150 lb. Jute Bags	100 lb. Paper Bags
Container Cost	1.20	.31	.13
Container Cost Per 100 lbs.	.60	.207	.13
Labor Cost	.0250	.0250	.0125
TOTAL COST Per 100 lbs.	.6250	.2320	.1425

CLASS OF PRODUCT PACKED

CEMENT	FERTILIZER
CHEMICALS	FOOD ✓
FEEDSTUFFS	MISCELLANEOUS

PRODUCT CHARACTERISTICS

ABRASIVE	GRANULAR
CORROSIVE	HEAVY
DELIQUESCENT	HYGROSCOPIC
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FREE-FLOWING	VISCOUS

ST. REGIS BAG PACKAGING

SYSTEMS are made in a variety of capacities, speeds, and manpower requirements to suit specific products and plant layouts. Machines are available in types to meet the special characteristics of a wide range of products, with filling speeds as high as twenty-four 100-lb. bags per minute — with one operator.

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BALTIMORE 2: 2601 O'Sullivan Bldg.
CHICAGO 1: 230 No. Michigan Ave.
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How **MULTIWALLS** *doubled* **PACKAGING PRODUCTION** and halved packaging costs!

Before this company switched to Multiwall Paper Bags, they were using barrels and jute bags. Three men were needed to fill and weigh these cumbersome containers. These three men were also required for the closing operations. Labor costs were high, while production seldom exceeded 9,000 lbs. per hour.

But, after the installation of Multiwall Bag-filling Machines, it was found that one man

could operate 2 filling machines while two other men checked and stacked the bags. This streamline operation results in the packaging of 18,000 lbs. per hour.

In addition, tight, siftproof Multiwalls overcame problems resulting from siftage, dampness, and infestation. And the compact storage of empty bags provided a substantial saving in valuable floor space.



Left: These 3 men pack, check, and stack 18,000 lbs. per hour in Multiwall Valve Bags. Below: Showing the tandem machine arrangement of the St. Regis machines which enables one man to do the bag-filling job.



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Mail this coupon for the complete story

I am interested in learning more about the economies of Multiwall Paper Bags. Please send me complete details concerning the "Case History" outlined above.

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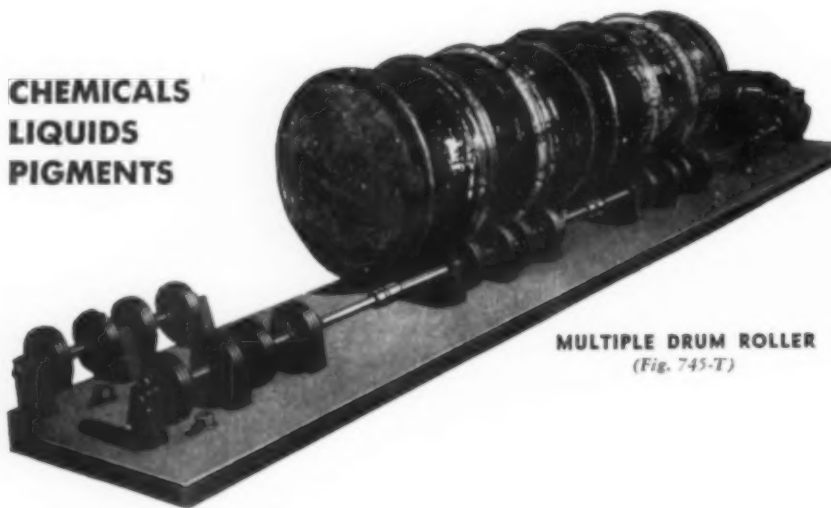
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—a better, faster way to mix or blend

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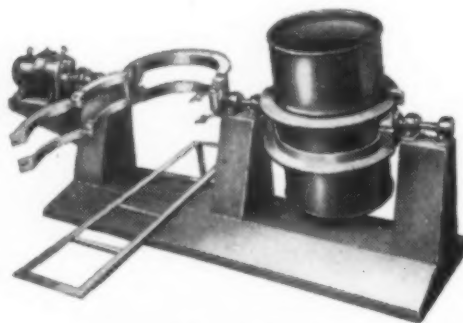
MULTIPLE DRUM ROLLER
(Fig. 745-T)

"U. S." adjustable Drum Rollers are made in standard units to handle one, two, three or four 55-gallon drums, up to 1,000 lbs. load per drum. Eight heavy-duty, rubber-tired wheels support each drum. The wheels are adjustable on the

shaft to provide ample clearance for rolling hoops and bung openings. Drum speed is approximately 30 RPM. "U. S." adjustable Drum Rollers can be made to handle any size drum, barrel, or round container.

Tumbling ACTION

When tumble-mixing or churning is required use "U. S." single or multiple Drum Tumblers. It takes only a few minutes to put the drum in position, fasten the adjustable yoke, and start the tumbling action. Standard "U. S." Drum Tumblers are built to handle one, two or three 5-, 30-, or 55-gallon Drums.



DOUBLE DRUM TUMBLER
(Fig. 730-D)

Visit Booths 89-90
20th Exposition of
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New York, Feb. 25, Mar. 3

See our display of
Drum Rollers, Drum Tumblers,
Jar Mills, Powder Blenders,
Jar Tumblers

PROCESS EQUIPMENT DIVISION



Since 1865 **U. S. STONEWARE** *Akron, Ohio*

those of which the 60-in. Berkeley cyclotron, now the most powerful in the world, is capable. The 60-in. machine was used to produce the world's first samples of the trans-uranic elements neptunium and plutonium as well as 95 and 96, as yet unnamed.

E. O. Lawrence, cyclotron inventor, predicted that new, undreamed-of elements will be produced; that fission can be obtained in many elements besides uranium and plutonium; and that cosmic rays will soon be produced in the laboratory.

Meanwhile, conversion of the Berkeley cyclotron to war on malignant disease was recently revealed by Dr. Lawrence, who stated that the 60-in. atom smasher will be used to produce long-life radioactive carbon for treatment of cancer and other disease. At the same time, Dr. Joseph G. Hamilton, assistant professor of radiology, said the university is using radioactive phosphorus to treat leukemia.

INTEREST IN GUAYULE RUBBER CONTINUES

GUAYULE rubber production should be carried on as a private enterprise and processing plants should not be dismantled until private firms have had opportunity to try practical development of a rubber industry.

This is the viewpoint of certain guayule growers, who oppose the plowing up of 30,000 acres planted to guayule and the junking of the two processing plants at Bakersfield and Salinas which are capable of turning out 5,000 lb. of rubber daily. Certain growers have shown interest in leasing the mills and forming an organization to keep the industry alive until the feasibility of competitive guayule can be determined.

Meanwhile, at Santa Barbara College of the University of California, research funds have been granted by the University to continue guayule research. Dr. F. T. Addicott and Dr. W. R. McRary will work on the project.

NEW CALIFORNIA PRODUCER OF FLUORESCENT PAINTS

BECOMING the second manufacturer of basic fluorescent materials in California and the sixth in the entire country, Rogers and Vogel of San Francisco are now offering to industry research and consulting services in fluorochemistry as well as a regular line of fluorescent paints, pigments and lacquers. With a factory on Mission St. in San Francisco, the new firm is a basic producer of inorganic phosphors, fluorescent and phosphorescent pigments, paints and lacquers, fluorescent cloths and high-quality specialty paints. The firm is headed by Frederick Rogers, lacquer specialist, and Marcel Vogel, fluorochemist.

ALL L. A. BUTADIENE UNITS TO CONTINUE OPERATIONS

WITH announcement of the 1946 program by the Office of Rubber Reserve, it was revealed that all units of the synthetic rubber industry in Los Angeles will continue operations. The new program calls for a total of approximately 413,000 tons of butadiene from which almost 600,000 tons of GR-S rubber will be made. The tentative schedule calls for 70,000 tons of butadiene from the three Los Angeles producers or

New **ELECTRONIC RESISTANCE THERMOMETER**

*for
Chemical
Processing*

THE BAILEY PYROTRON

As a resistance thermometer the Pyrotron indicates, records and controls temperatures between -100°F and 1200°F. It simultaneously records as many as four temperatures on its 12-inch chart, or may record and control as many as two temperatures.

An independent continuously connected measuring circuit serves each recording unit. These circuits are kept in continuous balance by sturdy motion-free electronic detectors which do away with the delicate parts and "step by step" action of galvanometer type instruments.

Indicating, recording and controlling instruments are furnished in rectangular casings as illustrated. Indicating and controlling instruments are furnished in 12-inch round type casings.

CHOICE OF THREE CONTROLS

Bailey Pyrotrons are furnished with the following types of Automatic Control:

- 1. AIR OPERATED**—Uses standard Bailey Pilot Valves, air relays, control valves and control drives. Operates by compressed air at 35 lb. pressure.
- 2. ELECTRONIC**—Uses standard electronic control panel operated from a control bridge in the Bailey Pyrotron.
- 3. ELECTRIC CONTACTS**—Uses micro switches on slidewire unit or electronic relay operated from control bridge in the Bailey Pyrotron.

P.5

*For details, request Bulletin 230-A "Bailey Pyrotron Electronic Resistance Thermometer".
Bailey Meter Company, 1054 Ivanhoe Road, Cleveland 10, Ohio.
In Canada—Bailey Meter Company Limited, Montreal.*

BAILEY METER COMPANY

1054 IVANHOE ROAD

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Controls for Processing



UNUSUAL FEATURES OF THE BAILEY PYROTRON

Suitable for severe service where vibration and shock exist.

Measuring circuit operates from instrument power supply eliminating need for standard cell and dry battery.

Sturdy electronic system maintains continuous balance.

Motor drive furnishes abundant power to operate recorders, controllers and alarm switches.

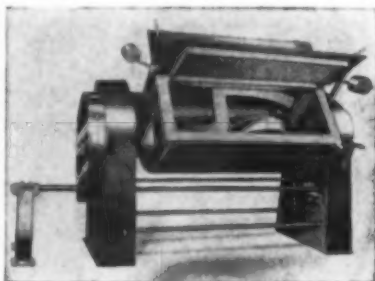
Two recording controllers may be housed in one casing.

Electronic units may be interchanged without disturbing instrument calibration.

TEMPERATURE
PRESSURE
% OXYGEN
% COMBUSTION
FLOW
LEVEL
DENSITY
RATIO

Paul O. Abbe MIXERS

Match Paul O. Abbe
Mills in efficient design
and sturdy construction.



FOR EXAMPLE:

The heavy duty mixer illustrated has "Z" type mixing blades, which overlap in operation, thus assuring thorough mixing of the batch and eliminating dead spots.



All drive parts of this mixer are completely enclosed.



This is one of many types of mixers, for dry, liquid and paste materials, manufactured by Paul O. Abbe for use in many industries.



Send for our new Mass and
Paste Mixer folder, free on
request.

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375 Center St.

LITTLE FALLS, N. J.

approximately 17 percent of the nation's total.

All alcohol butadiene plants in the country will be closed down, and three of the naphtha process units will discontinue operations. This leaves the Southern California Gas Co. plant as the only butadiene unit using the petroleum naphtha process to continue. This plant has proved valuable as a source of ethylene for styrene and other by-products as well as for its close tie-up with other butadiene plants of the area. Schedules for butadiene producers in the Los Angeles area for 1946 are as follows: Southern California Gas Co., Los Angeles, to produce 30,000 tons of butadiene using naphtha as a raw material; Shell Union Oil Co., Torrance, 25,000 tons from butylene; Standard Oil Co. of Calif., El Segundo, 15,000 tons from butane.

ELECTROLYTIC MANGANESE PROVES ADVANTAGES

COOPERATIVE tests with two steel mills have shown that pure electrolytic manganese produced from low-grade domestic ores in a Bureau of Mines pilot plant at Boulder City, Nev., has definite advantages as a substitute for low-carbon ferromanganese in the manufacture of stainless steels, according to a report by the U. S. Bureau of Mines. Comparative tests showed no appreciable difference in average recovery obtained from the two forms of manganese, but the electrolytic manganese showed advantages in meeting the low maximum specifications for phosphorus and carbon. Electrolytic manganese offered operating advantages because of its purity and physical form and, despite its present higher cost, one of the steel mills intends to use this form of manganese exclusively.

NEW PLANT FOOD FACTORY FOR BAY AREA

WITH the purchase of a six-acre site at the southwest limits of Hayward, Alameda County, Calif., the Swift & Co. Fertilizer Works announces that construction work on a new plant food factory is expected to start in the very near future. The new plant will use minerals and synthetic materials principally as raw materials. The Hayward unit will provide Swift & Co. with two modern plant food factories in California, the other being located at Los Angeles.

TWO NEW AICHE SECTIONS FOR CALIFORNIA

Two new AICHE local sections, both in California and the first west of the Rockies, were approved by the institute council at the December convention in Chicago. Both chapters were organized little more than a year ago, and both have shown steady growth and enthusiastic attendance. The Southern California section includes the Los Angeles area and is headed by Dr. R. E. Vivian, dean of the College of Engineering of the University of Southern California as chairman. O. N. Anderson of Procter and Gamble Co., Long Beach, is secretary-treasurer.

The Northern California section, including the San Francisco Bay area, has as chairman Dr. C. R. Nelson, Shell Development Co., San Francisco. Mott Souders, Jr., also of Shell

Development, is secretary-treasurer of this group, which as of mid-December had a paid membership of exactly 100. The Northern California section held 12 meetings during the past year, alternating between Berkeley and San Francisco, for which the average dinner attendance was 76 and average meeting attendance 85. As of the first of October, this group had a total mailing list of 208 consisting of 128 institute members and 80 non-members. Similar data on the Southern California section are not yet available.

ELECTROCHEMICAL UNIT FOR NEVADA—CORRECTION

IN THE November issue of these columns it was incorrectly stated that the Bristol Silver Mines Co. planned construction of an electrochemical zinc-lead reduction plant near Pioche, Nev. This statement was erroneously attributed to J. H. Buehler, mine manager of the firm. Instead, unconfirmed reports indicate that erection of such a reduction plant, to use Boulder Dam power, has been under consideration by Combined Metals Reduction Co., Salt Lake City, but that plans have not yet advanced beyond the research stage.

RUBBER PLANT FOR CALIFORNIA AUTOS

FURTHER evidence that Los Angeles has grown into the West's center of automobile production is shown by the recent announcement that Ohio Rubber Co. will erect a \$1,000,000 automobile supply plant in northern Long Beach. Franklin G. Smith, company president, said the plant would be built on a 20-acre site. It was reported that the firm already holds contracts with Ford, Studebaker, Willys, Chrysler and General Motors to turn out floor mats and step plates for automobiles assembled in Los Angeles.

ALCOHOL FROM POTATOES PRODUCED IN IDAHO

Now producing beverage grade alcohol from cull potatoes, the Bonnerville Distillery at Idaho Falls, Idaho, a subsidiary of Galesworthy, Inc., Newark, N. J., is the only plant of its kind to operate in the Pacific Northwest. According to reports, the process has proved successful and the firm intends to enlarge its Idaho Falls distillery, and to establish another plant in the Caldwell vicinity. Byproducts now discarded will probably be processed into a dairy feed. Since it is not possible to get potatoes the year round, the plant also uses grain, 90 percent barley and 10 percent wheat. Original design capacity of the alcohol plant is reported to be in the neighborhood of 1,000 gal. per day.

WINERY WASTES NOW YIELD TARTRATES

FIRST winery to use the Marsh-Vaughn-Montgomery system of still slop disposal and continuous tartrate recovery is the large unit of Italian Vineyard Co., at Cucamonga, Calif., which has been in successful operation since early September. Based upon the fact that tartrate removal reduces the removal of B.O.D. of the distillery slop by about 50 percent, the process removes calcium tartrate continuously from the dilute

FOR MAXIMUM SAFETY AND CONTINUITY OF SERVICE

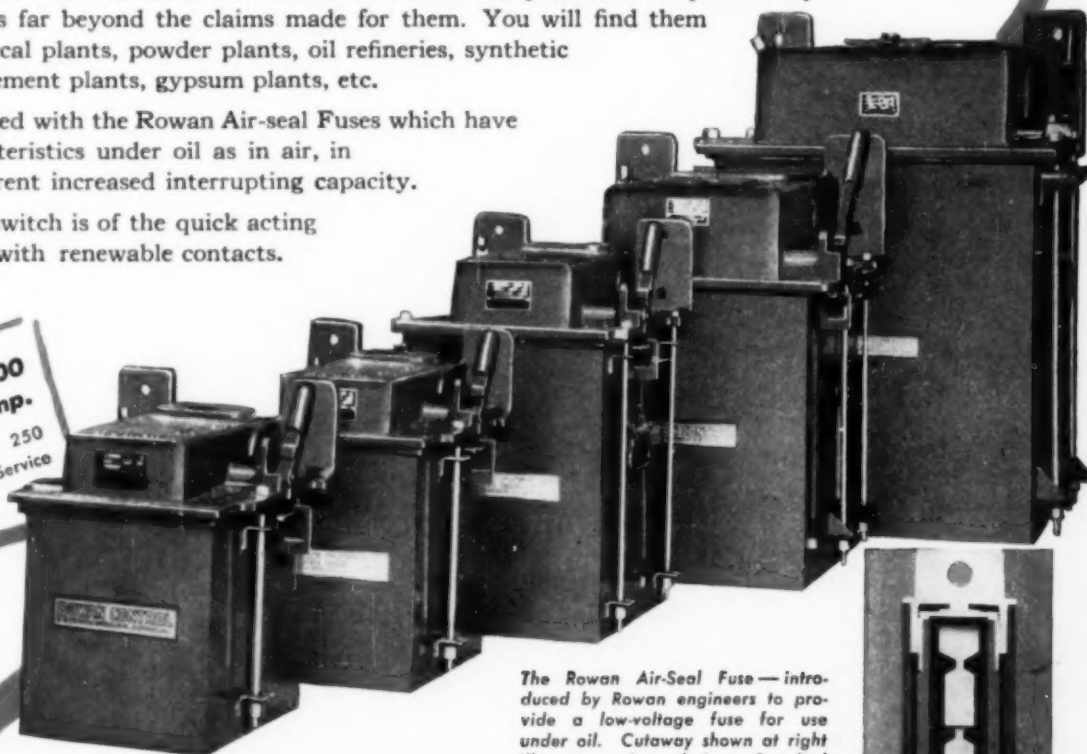
Rowan COMPLETELY OIL IMMERSED, FUSED, SAFETY LINE DISCONNECT SWITCHES

Designed and time-tested for locations where the atmosphere is contaminated with corrosive elements, semi-hazardous and hazardous vapors and dust. Continuity of service under these conditions and adverse weather conditions has proved the dependability of these switches far beyond the claims made for them. You will find them located in chemical plants, powder plants, oil refineries, synthetic rubber plants, cement plants, gypsum plants, etc.

They are equipped with the Rowan Air-seal Fuses which have the same characteristics under oil as in air, in addition to inherent increased interrupting capacity.

The disconnect switch is of the quick acting contactor type with renewable contacts.

30—60—100
200—400 amp.
Available for 250
and 600 Volt Service



The Rowan Air-Seal Fuse—introduced by Rowan engineers to provide a low-voltage fuse for use under oil. Cutaway shown at right illustrates unique design. Supplied in 30—60—100—200—400 amp., 250 and 600 Volt.

Other features of the Rowan Oil Immersed Disconnect Switch are:

1—ROWAN AIR-SEAL fuses. 2—Completely oil immersed. 3—Disconnect switch of the quick acting contactor type with renewable contacts. 4—Safety enclosing case mechanically interlocked to prevent lowering of tank when switch is in operating position or closing of switch when tank is lowered. 5—Enclosing case is weather-resisting and dust-tight. 6—PROVISION for locking disconnect switch in "off" position. 7—Tank handles for ease of handling.

The Rowan Controller Company has specialized in Oil Immersed Controls for nearly half a century. Results and performance achieved by users justify the Rowan claim of superiority in this field. Write for complete information on Rowan Oil Immersed Controls.

ROWAN CONTROL
THE ROWAN CONTROLLER CO., BALTIMORE, MD.

slops and at the same time disposes of this waste to best advantage, depending upon location of the winery. Principles of the new process were worked out by Profs. George L. Marsh and Reese H. Vaughn of the University of California, Berkeley, while design and mechanization of the Cucamonga plant was done by J. M. Montgomery & Co., of Los Angeles.

GOVERNMENT PROCESS PLANTS NOW FOR SALE

APPROXIMATELY 75 chemical, process or process equipment plants were built in the West with government financing during the war, according to recent RFC compilations. These plants, with some exceptions, are now for sale or lease to private industry. The accompanying table lists these plants and

their capacities, together with approximate plant and building areas, and indicates which units were under negotiations for sale or lease at mid-November. Detailed information on any of the plants listed as surplus can be obtained from Reconstruction Finance Corp. offices in Denver, Helena, Los Angeles, Portland, Salt Lake City, San Francisco, Seattle or Spokane.

Government-Owned Chemical and Related Plants in the West

Type of Plant	Lessee or Operator	Plant Location	Capacity, Tons per Year	Plant, Acres	Total Area Buildings, Sq. Ft.
Acetylene.....	Air Reduction Sales Co.....	Portland, Ore.....	14,400,000 CF	4.6	7,300
Acid-grade fluorspar*	Zuni Milling Co.....	Los Lunas, N. M.....	3,000 (mo.)	47.7	14,400
Alcohol (wood waste)*	Willamette Valley Wood Chemical Co.....	Springfield, Ore.....	4,100,000 gal.	14	.....
Alcohol (sulphite liquors)*	Puget Sound Pulp & Timber Co.....	Bellingham, Wash.....	6,140 GPD	1.25	42,300
Alumina (from anorthosite)*	Monolith Portland Midwest Corp.....	Laramie, Wyo.....	18,000	40	142,000
Alumina (from clay)*	Columbia Metals Corp.....	Salem, Ore.....	18,000	100	14,000
Aluminum extrusion and tubing.....	Aluminum Co. of America.....	Phoenix, Ariz.....	24,750	285	1,450,000
Aluminum ingots*	Aluminum Co. of America.....	Riverbank, Calif.....	48,000	19	476,000
Aluminum ingots.....	Aluminum Co. of America.....	Torrance, Calif.....	80,000	129	860,000
Carbon electrodes.....	Bohn Aluminum & Brass Corp.....	Los Angeles, Calif.....	28,800	38	379,000
Aluminum extrusion***	Merrill Products Co.....	Emeryville, Calif.....	5,850	.....	.....
Aluminum powder.....	Aluminum Co. of America.....	Troutdale, Ore.....	1,800	590	825,000
Aluminum ingots.....	Aluminum Co. of America.....	Troutdale, Ore.....	64,000	.....	.....
Alumina (from alunite).....	Kalunite, Inc.....	Salt Lake City, Utah.....	43,200	79	82,000
Aluminum ingots.....	Aluminum Co. of America.....	Spokane, Wash.....	36,000	254	1,000,000
Aluminum ingots.....	Olin Industries, Inc.....	Tacoma, Wash.....	96,000	99.5	233,000
Aluminum sheets.....	Aluminum Co. of America.....	Trentwood, Wash.....	20,750	325	2,263,000
Aluminum chloride*	Hooker Electrochemical Co.....	Tacoma, Wash.....	144,000	0.66	14,850
Asbestos processing.....	Pine Top Asbestos Mine.....	Globe, Ariz.....	225 (mo.)	8.28	3,000
Butadiene**	Shell Union Oil Co.....	Globe, Ariz.....	.....	8.28	3,000
Butadiene**	Southern California Gas Co.....	Los Angeles, Calif.....	30,000	95	87,000
Butadiene**	Standard Oil Co. of California.....	Los Angeles, Calif.....	35,000	1.6	20,000
Bomb assembly.....	Day and Night Flare Corp.....	El Segundo, Calif.....	15,000	8.5	29,000
Butane.....	Bay Petroleum Corp.....	San Bernardino, Calif.....	.....	637	107,800
Calcined magnesite.....	Westvaco Chlorine Products Corp.....	Denver, Colo.....	130 BPD	.....	.....
Chemical warfare**	Chemical Warfare Service.....	Newark, Calif.....	100 (day)	.....	4,100
Chromium ore*	Anaconda Copper Mining Co.....	Denver, Colo.....	.....	.....	.....
Chromium ore*	Anaconda Copper Mining Co.....	Columbus, Mont.....	1,000 (day)	.....	94,500
Coke and byproducts.....	Colorado Fuel & Iron Corp.....	Columbus, Mont.....	2,000 (day)	.....	300,000
Chromium oxide.....	Southwestern Engineering Co.....	Minneapolis, Colo.....	327,000	.....	.....
Calcium tungstate*	U. S. Vanadium Corp.....	Marshfield, Ore.....	400 (day)	60	13,500
Coke and byproducts.....	Wilkeson Products Co.....	Salt Lake City, Utah.....	.....	2.9	20,000
Charcoal (from wood)***	Const Carbons, Inc.....	Tacoma, Wash.....	75,000	6.5	6,000
Calcium carbide***	Pacific Carbide & Alloys Co.....	Tacoma, Wash.....	450 (mo.)	23	61,700
Copper ore reduction.....	Castle Dome Copper Co., Inc.....	Tacoma, Wash.....	1,000 (mo.)	15.3	142,800
Copper metal (electrolytic).....	Phelps-Dodge Corp.....	Miami, Ariz.....	12,000 (day)	77.13	189,000
Copper tube and pipe.....	Phelps-Dodge Copper Products Corp.....	Morenci, Ariz.....	60,000	25	295,000
Fire brick.....	Gladling, McBean & Co.....	Los Angeles, Calif.....	.....	41.3	187,500
Ferrosilicon.....	Wenatchee Alloys, Inc.....	Lehi, Utah.....	4,000,000 units	14.7	25,800
High-octane gasoline.....	Mohawk Petroleum Corp.....	Rock Island, Wash.....	16,200	39.3	41,000
High-octane gasoline.....	Wilshire Oil Co., Inc.....	Bakersfield, Calif.....	3,000 BPD	20	30,000
High-octane gasoline***	Standard Oil Co. of California.....	Norwalk, Calif.....	6,000 BPD	20.6	19,200
High-octane gasoline***	Utah Oil Refining Co.....	Richmond, Calif.....	8,000 BPD	40.8	57,250
High-octane gasoline*	Frontier Refining Corp.....	Salt Lake City, Utah.....	5,540 BPD	31.5	59,000
Incendiary bomb assembly.....	Day and Night Flare Corp.....	Cheyenne, Wyo.....	1,650 BPD	25	67,000
Magnesium metal.....	Permanent Metals Corp.....	Turlock, Calif.....	.....	154	88,900
Metallurgical fluorspar.....	Western Fluorspar Corp.....	Manteca, Calif.....	10,000	138	258,800
Manganese concentrates.....	Domestic Manganese & Development Co.....	Northgate, Colo.....	500 (day)	3.44	3,000
Magnesium metal.....	Basic Magnesium, Inc.....	Butte, Mont.....	125 (day)	1.5	17,900
Manganese oxide ore.....	Basic Magnesium, Inc.....	Henderson, Nev.....	56,000	.....	.....
Manhattan physics laboratories**	Manganese Ore Co.....	Las Vegas, Nev.....	90,000	446	63,500
Magnesium chloride.....	U. S. Army.....	Los Alamos, N. M.....	.....	.....	.....
Magnesium } Ferrosilicon }	International Minerals & Chemical Corp.....	Carlsbad, N. M.....	30,900	6.25	60,000
Oxygen.....	Electro Metallurgical Co.....	Spokane, Wash.....	28,000	440	355,000
Oxygen.....	Air Reduction Sales Co.....	Emeryville, Calif.....	60,000,000 CF	.....	.....
Oxygen.....	National Cylinder Gas Co.....	Los Angeles, Calif.....	46,800,000 CF	.....	.....
Oxygen.....	Stuart Oxygen Co.....	San Francisco, Calif.....	46,080,000 CF	.....	.....
Oxygen*	Seattle Oxygen Co.....	Seattle, Wash.....	36,000,000 CF	.....	.....
Potassium perchlorate*	Western Electrochemical Co.....	Los Angeles, Calif.....	2,760	3	34,400
Penicillin.....	Cutter Laboratories, Inc.....	Berkeley, Calif.....	.....	0.3	19,840
Pig iron (with coke plant)*	Columbia Steel Co.....	Ironton, Utah.....	300,000	276	.....
Plutonium and byproducts**	E. I. du Pont de Nemours.....	Richland, Wash.....	.....	.....	.....
Steel castings*	Columbia Steel Co.....	Pittsburg, Calif.....	30,000	43	340,000
Sulphuric acid.....	General Chemical Co.....	El Segundo, Calif.....	65,000	.....	.....
Synthetic rubber**	Goodyear Synthetic Rubber Corp.....	Los Angeles, Calif.....	90,000	84.2	359,000
Styrene**	Dow Chemical Co.....	Los Angeles, Calif.....	25,000	106	80,000
Synthetic rubber catalyst.....	Westvaco Chlorine Products Corp.....	Newark, Calif.....	5,100	4.75	20,000
Steel scrap*	California Scrap Iron Corp.....	Pittsburg, Calif.....	45,000	6	2,600
Steel tubing.....	Pacific Tube Co.....	Los Angeles, Calif.....	24,100	16	115,000
Salt*	California Rock Salt Co.....	Salton, Calif.....	60 (hr.)	13.2	5,200
Sulphuric acid***	General Chemical Co.....	Richmond, Calif.....	65,000	10	.....
Sulphuric acid.....	General Chemical Co.....	Denver, Colo.....	25,000	.....	.....
Superphosphate.....	J. R. Simplot Fertilizer Co.....	Pocatello, Idaho.....	60,000	10.4	36,200
Silica sand*	Silica Products Oregon, Ltd.....	Eugene, Ore.....	.....	10	.....
Vanadium oxide.....	Vanadium Corp. of America.....	Monticello, Utah.....	100 (day)	186	53,000
Vanadium oxide.....	Blanding Mines Co.....	Blanding, Utah.....	600 (mo.)	5	10,700
Yucca fibers and powder.....	General Fiber Products Corp.....	McConnico, Ariz.....	.....	9.3	9,000

* Negotiations reported under way for sale or lease. ** Not declared as surplus. *** Leased or sold to private industry.

No Plant Operator Can Afford

OBSOLETE POWER TRANSMISSION EQUIPMENT

Whether you generate your own power or buy it from an outside source, you cannot afford to waste it; therefore you cannot afford obsolete power transmission equipment.

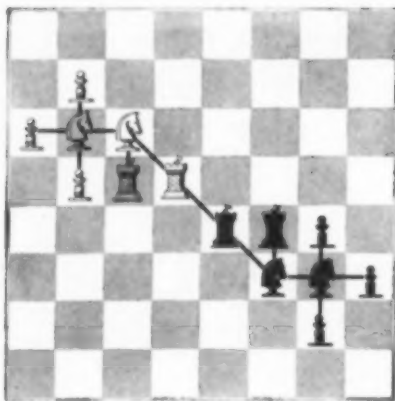
Modern line shaft hangers and pillow blocks equipped with Timken Tapered Roller Bearings are saving power and time and slashing maintenance costs in thousands of factories by eliminating friction and wear; simplifying lubrication; providing full protection against radial, thrust and combined loads; and holding shafts constantly in alignment.

Throw out those obsolete power wasters now and replace with Timken Bearing Equipped power savers. Make sure the trade-mark "TIMKEN" appears on every bearing you use. The Timken Roller Bearing Company, Canton 6, Ohio.



*A modern power-saving
Dodge-Timken Pillow Block.*

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TAPERED ROLLER BEARINGS



This is not a game of skill ...IT'S BECCO ACETYL PEROXIDE

Perhaps chess was played before Brodie first began his investigations of Acetyl Peroxide in 1863; and certainly prior to a continuation of his studies by Vanino, Clover, Richmond, Gambarian and Kharash. But its use was more risky than playing chess, for Kharash said of Acetyl Peroxide in the Journal of the American Chemical Society: "An outstanding peroxide of great usefulness but must be used on the spot (of manufacture) because of its sensitivity."

Chemists of the Buffalo Electro-Chemical Company, Inc., have developed a process for making solutions of acetyl peroxide which are perfectly safe to handle. It can, at present, be furnished in laboratory size samples only. It is a 30 percent solution of acetyl peroxide in dimethylphthalate, water white, non-explosive and immune to shock and impact.

Besides its value as a polymerization agent, other interesting applications include its use as a germicide, a bleaching and oxidizing agent, and in vulcanization. It has great possibilities in organic syntheses as it is very reactive and offers a source of active oxygen in a non-aqueous medium. Write for laboratory samples.

ACTIVE OXYGEN IS ON ACTIVE DUTY Other Becco Products:

Electrolytic Hydrogen Peroxide,
100 vol. (27.5% by weight)
Ammonium Persulfate
Potassium Persulfate
Magnesium Peroxide*
Calcium Peroxide*
Zinc Peroxide*
Pyrophosphate Peroxide*
Sodium Carbonate Peroxide*
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*Available in research quantities only at present.

**BUFFALO ELECTRO-CHEMICAL
COMPANY, INC.**



BECCO SALES CORPORATION
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NEWS FROM ABROAD

HUGE IMPERIAL CHEMICAL INDUSTRIES PROJECT STARTS BRITISH PLANT CONSTRUCTION PROGRAM

Special Correspondence

WHATEVER THE political implications of the Anglo-American financial agreement and its effect on Britain's future monetary and commercial policies, there is no doubt that its conclusion has been greeted with relief if not with unqualified satisfaction in British business circles. Such industries as the chemical trades which to a considerable extent depend on foreign raw materials hope that the financial elbow room provided by the U. S. credit will enable the government to be somewhat more generous and accommodating in the grant of import licenses and import currency for the purchase of raw materials. As the shipping situation has steadily and substantially improved during the past few months and such minor obstacles as the shortage of containers promise to resolve themselves, chemical manufacturers like other business men are glad to hear that the threat of a financial bottleneck narrowing the stream of imports down to less than the physically possible volume has been overcome.

Nor is there any serious doubt that British industry can stand the severe but bracing climate of free competition in an open world market once wartime damage and neglect of plants, has been made good.

This view is borne out by the official foreign trade statistics for the July-September period which was one of transition but clearly showed the great opportunities open to British chemical exporters. The export total of chemical manufactures, drugs, dyes and colors in Class III 0 of the official classification was £10,170,000—one of the highest figures on record, and even for the total of the first nine months of 1945 which after all includes several months during which shipments of industrial products were impaired by the more urgent needs of warfare, the physical volume of chemical exports (after suitable deductions from export figures to offset wartime changes in prices) was about equal to the corresponding figure for 1938. There is thus every prospect that British chemical exports will, both in volume and value, for some time at least remain substantially above the prewar figures.

Important bulk export articles of British inorganic chemical industry are soda ash, soda crystals, sodium bicarbonate, and caustic soda, sodium sulphate, sodium silicate, copper sulphate, zinc oxide, and aluminum sulphate, and most of these show advances. The leading foreign markets are those supplied by British

Immersion Heating with VITREOSIL (Vitreous Silica) HEATERS

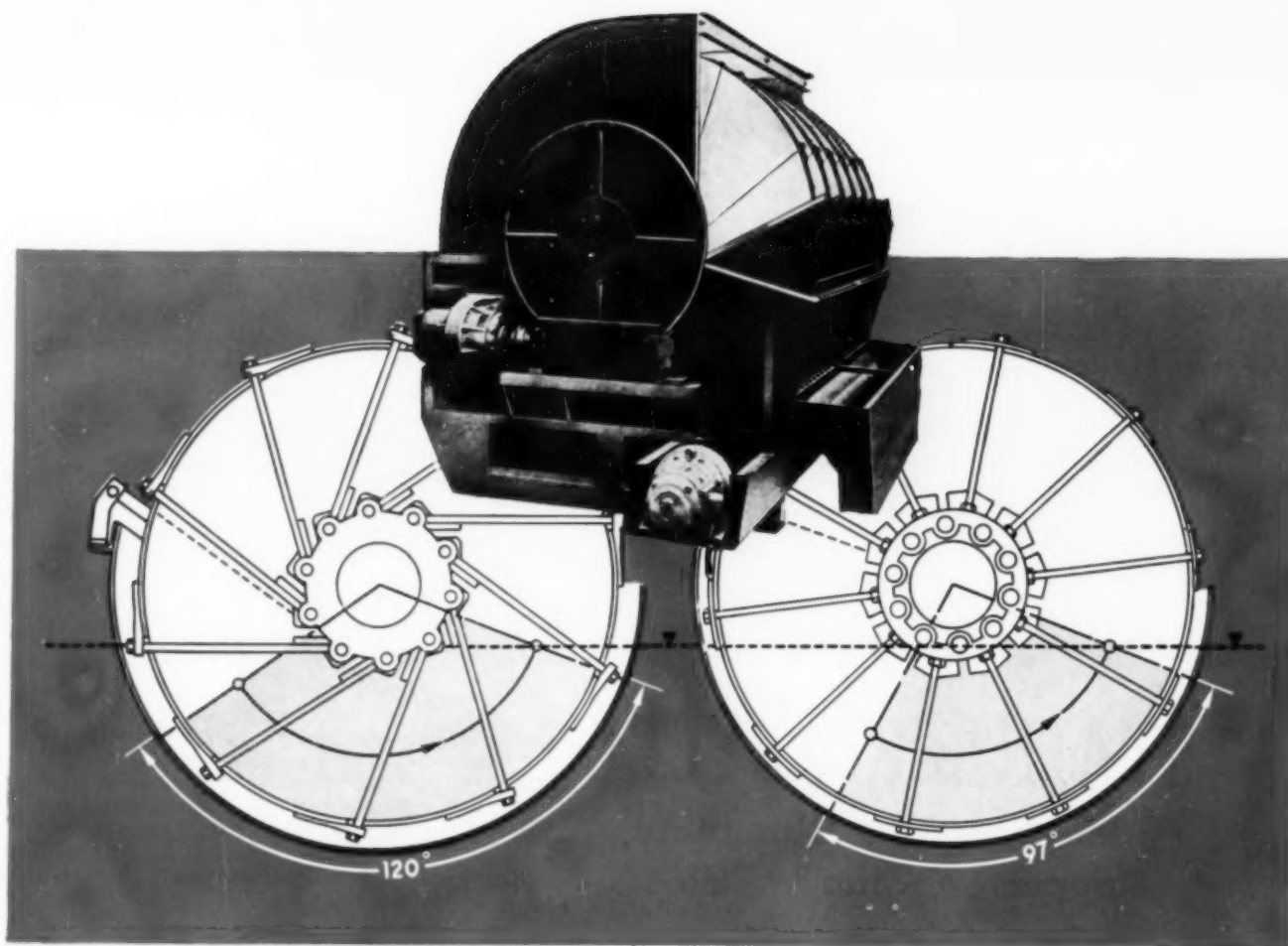


When other methods are unsatisfactory, acid solutions in tanks of any material can safely be heated by Vitreosil electric immersion heaters.

Send for Bulletin #2



The THERMAL SYNDICATE Ltd.
12 East 46th St. New York 17, N. Y.



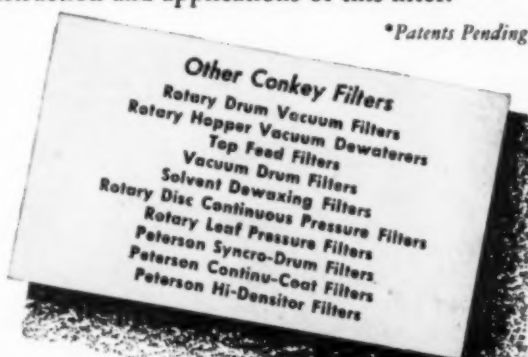
NEW DESIGN PROVIDES 23% MORE CAKE BUILDING PICKUP TIME!

The Conkey Rotary Disc Vacuum Filter, equipped with the improved Conkey tangential-segment disc*, provides a 23% increase in dewatering capacity over a conventional "pie-shaped" design filter of equivalent diameter and number of discs.

For dewatering operations, within the particle size range for correct filter application, these units provide a filter means of established usefulness in process operations. For such applications, Conkey multiple-disc filters are lower in cost, and have a greater dewatering capacity in proportion to floor space occupied, than any other type of continuous filter.

Write for bulletin #102 describing the design, construction and applications of this filter.

*Patents Pending



General American

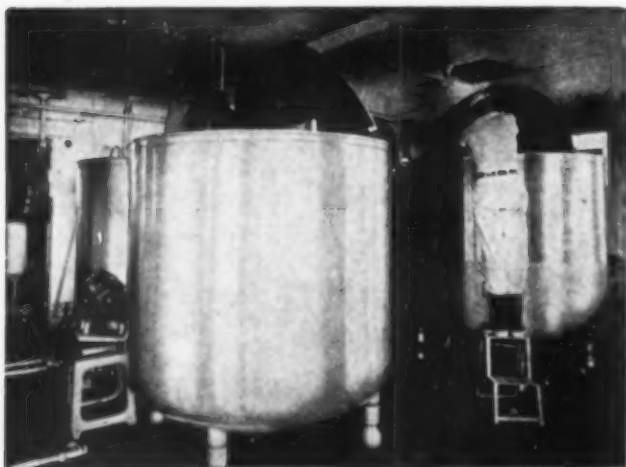
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Division of The Edwards Manufacturing Co.

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makers before the war, but liberated countries of Europe accounted temporarily for a rather bigger share in the total. Exports of fertilizers have been resumed and increased, but shipments will be limited by the keen demand from British agriculture. As far as coal-tar products are concerned, the situation up to September was overshadowed by U. S. requirements. Such highly valued export articles as dyestuffs and paints did particularly well in comparison with prewar days.

It would be premature to draw from the July-September figures any far-reaching conclusions regarding the future of British chemical exports. Restocking and urgent calls from continental Europe added to foreign demand, while the gradual, slow removal of export controls and persisting shortages hampered foreign sales. As far as imported raw materials are concerned, the end of the war has made it possible to relax and remove control in various directions, while the falling off of demand allowed a drastic curtailment of purchases of materials of which substantial stocks had been accumulated in anticipation of continued war-scale requirements. Thus the import statistics up to September are even less characteristic of what may be imported in future than are this year's export shipments of future sales abroad. Among fertilizers there has been a big increase in arrivals of Chilean nitrates and potash salts, and this is likely to continue, while among phosphatic fertilizer imports there is likely to be a change from superphosphates to crude phosphates.

I.C.I.'S NEW PROJECT

By far the most important event in the chemical industry is the announcement by Imperial Chemical Industries of a project for the expenditure of not less than £10,000,000 (\$40,000,000) on the erection of large-scale works for the production of heavy organic chemicals at Wilton, three miles from Middlesborough, in northeast Yorkshire. This is the greatest single industrial project so far announced by British industry. The site acquired for the plant covers more than five square miles and will be developed over the next five years. It has been chosen for the availability of a combination of essential raw materials. Adequate quantities of coal will be obtained from the Durham coal field. There is an ample supply of salt. The large amount of cooling water needed will come from the Tees Estuary. The Tees Conservancy contemplates the construction of deep-water docks little more than a mile away, so that imported oil will be available without great costs of inland transport and manufactured goods can be shipped easily.

As far as industrial plant erection is concerned, it has been officially stated that there will be installations for the production of sulphuric acid, an electrolytic chlorine-caustic soda plant, and a vacuum salt plant. Space and facilities will be available for the manufacture of new products developed as a result of research.

The site which is in one of the "development areas" which because of past neglect and consequent social distress received special government attention will thus be equipped with the necessary inorganic chemical plants, but the main pur-



GRINNELL

PIPING
PROGRESS

Heat Treating Stainless Steel Piping

Question: Why might it be necessary to heat-treat unstabilized chromium-nickel alloy steel pipe after fabrication?

Answer: To eliminate precipitated carbides which decrease the corrosion-resisting quality of the steel.

Heat treating consists of heating the prefabricated pipe at a predetermined rate to a specified temperature, maintaining such temperature for a certain time and then cooling at another predetermined rate.

The picture above illustrates heat treating welds on a 180° bend in a modern muffled-type gas furnace.

WHENEVER PIPING IS INVOLVED

There are many types of alloy steel – each with its own particular properties and characteristics, such as reactions under the heat of welding and bending. Grinnell engineers are familiar with these reactions and have developed closely controlled and metallurgically supervised procedures for fabricating alloy piping to obtain the full advantages of alloy steels for corrosion re-

sistance and for high pressure and high temperature applications.

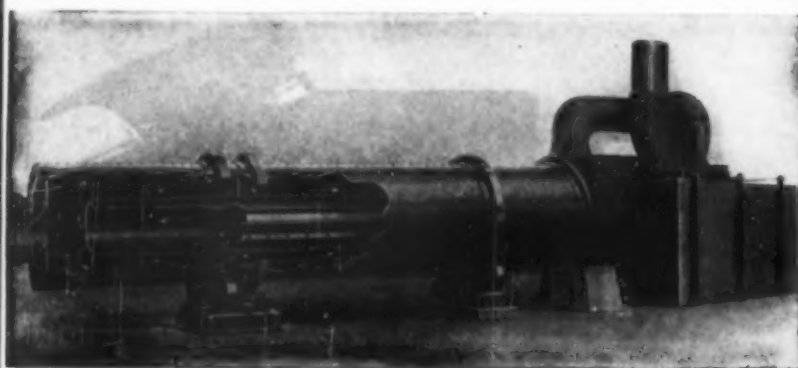
Whatever the piping requirements, Grinnell has the specialized engineering knowledge and experience to handle the job – from first plan to actual operation. Grinnell can supply everything from a tiny tube fitting to a complete power plant installation.

GRINNELL COMPANY, INC. Executive Offices, Providence 1, R. I. Branch warehouses in principal cities. Manufacturing Plants: Providence, R. I.; Cranston, R. I.; Atlanta, Ga.; Warren, Ohio; Columbia, Pa.

GRINNELL



WHENEVER PIPING IS INVOLVED



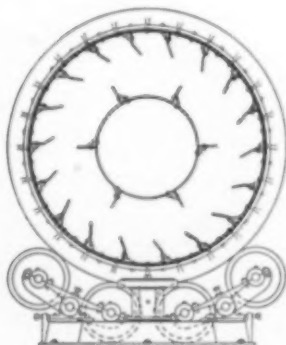
Diagram, Ruggles-Coles Class "XA" Dryer, showing flow of gases

RUGGLES-COLES DRYERS FOR UNCHALLENGED ECONOMY

**SPECIFY THIS GRAND OLD NAME IN
DRYERS . . . BUILT BY HARDINGE**

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Ruggles-Coles Dryers require less fuel than any other make because of complete combustion of fuel, small radiation losses, and low temperature of both the exhaust gases and dried material. Remember the "grand old name"—Ruggles-Coles.



**Cross-sectional view of
Class "XA" Dryer . . .**

The shell consists of two long concentric steel plate cylinders. Gases of combustion generated in the furnace pass down inner flue, turn at discharge end, and pass back between inner flue and outer shell. They are then drawn out by an induced draft fan.

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Write for Bulletin 16-C, covering the entire line of
HARDINGE-BUILT RUGGLES-COLES DRYERS.

pose of the project is to develop the heavy organic side of the British chemical industry on a scale adequate to meet the country's needs. The great enterprise was initiated in April 1944 with the knowledge and approval of the government departments concerned. A labor force of 3,000 people will be required for construction and development, and when the project has come to full fruition, it will presumably give employment to 10,000 persons or more. In financial quarters it is stated that the company does not intend to make a fresh issue of capital. The first stages of the project, at any rate, will apparently be financed from the company's own resources.

NEW NYLON PLANT

Another expansion of major importance announced this month concerned British Nylon Spinners Ltd., the joint subsidiary of I.C.I. and Courtaulds formed in 1940 with £300,000 capital. The authorized capital will now be increased to £1,000,000 of which £800,000 will be issued and paid up immediately. The new funds are needed for building the contemplated big nylon yarn plant near Pontypool in South Wales and will cover expenditure in the near future. In every one of the next few years, however, the company will have to raise further finance. The plant is expected to come into production early in 1948. A small pilot plant to train operatives will be running twelve months earlier. At present nylon is spun into yarn and fibers by British Nylon Spinners Ltd. at Coventry, where the Courtaulds combine has a big plant. Nylon bristles are made by the plastics division of I.C.I. at Welwyn near London.

Celanese, the other big British rayon producer, is also projecting various expansion schemes. At the annual meeting it was revealed that the company has many new productions which it intends to offer as soon as possible. The commercial output, however, depends in the first place on acquisition of the necessary machinery and labor and secondly on the alleviation of certain controls. Apart from entirely new developments, Celanese has under consideration plans for further increasing factory production capacity. Special expectations are based on Fortisan, the strong Celanese yarn developed before the war which has been used on a large scale for parachute fabrics, cords, ropes and other materials normally made from silk, flax or ramie. It has been used to replace oil silk in electrical, surgical and other fields, in polishing cloths for high-precision instruments, in super light-weight fabrics interwoven with wire for radar apparatus, and for mosquito nets.

Another field of chemical interest in which large-scale investments and developments may soon be expected is the gas industry. An expert inquiry committee has reported in favor of nationalization of the gas industry now largely controlled by private firms and local authorities, and this nationalization, for which the labor program provides in any case, will presumably soon be effected in conjunction with, or shortly after, the nationalization of the coal mines. It may then be found that the coke-oven industry will also be brought under public

Jones

WORM-HELICAL SPEED REDUCERS

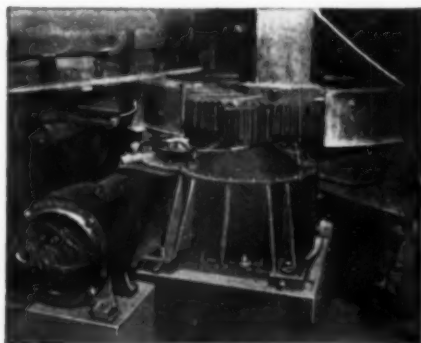
*- for Vertical Shaft
Drives*



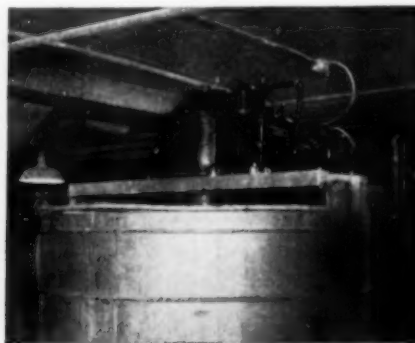
THESE machines fill a long felt need for double reduction units of the fully enclosed type to be used for agitators, mixers, ore roasters, bending rolls, etc., requiring a vertical shaft drive. Built in standard ratios in various types of assemblies ranging from 40 to 1 to 250 to 1 for all common motor

speeds and a wide range of horsepower ratings.

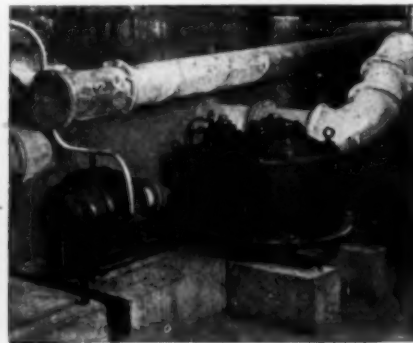
Jones Bulletin No. 75 covers complete details on these Worm-Helical Speed Reducers, with rating tables, dimension diagrams, torque charts and other application information. We shall be pleased to send you a copy.



● Jones Worm-Helical Speed Reducer on ore roaster with section of dust guard removed to show final gear reduction.

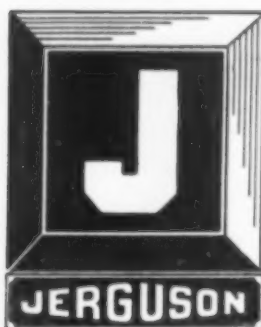


● Jones Worm-Helical Speed Reducer driving a lacquer agitator. A simple design prevents leakage of oil along the vertical low speed shaft.



● Jones Worm-Helical Speed Reducer on a paper mill agitator drive.

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SEATTLE 9, WASHINGTON
Arthur Forsyth Company

ST. LOUIS 11, MISSOURI
O'Brien Equipment Company

TULSA 12, OKLAHOMA
W. D. Emery Company

MONTREAL 13, P. Q., CANADA
Peacock Brothers Ltd.

MEXICO, D. F.
Tecnica y Equipos, S. A.

ownership or control. The prospect of nationalization does not, however, interfere with the development of projected new enterprises.

Even in the coal mining industry, most immediately threatened by nationalization, the Doncaster Amalgamated Collieries propose to open a new mine at Pigburn at a cost of £750,000. Dorman Long, the big iron and steel combine, is reported to project erection of a new plant requiring an expenditure equalling if not exceeding that of the I. C. I. project at Wilton. Altogether, plans for 600 new factories have been licensed by the Board of Trade, about half of them in "development areas," and 15 new Trading Estates will be set up. No less than 170 government factories have been allocated for civilian use, to provide employment eventually for 300,000 to 400,000 people.

BRITISH TO TRAIN ENGINEERS FOR EXECUTIVE POSITIONS

RECOGNIZING a deficiency in the number of trained engineers capable of rising to executive positions in chemical, mechanical and electrical industries, and pointing clearly to shortcomings of the present system of higher education, a committee of British educators and industrial executives has recommended considerable revision and extension of the engineering courses offered by some 150 technical schools and colleges to supplement the output of the 13 university-type colleges now empowered to grant degrees in engineering and thus arrive at a goal of about 3,000 yearly graduates capable of becoming industrial administrators, development engineers, designers, managers, production experts and technical salesmen. Prewar output probably did not exceed 2,300 men in all classifications of science and engineering.

Committee recommendation envisages the selection of a strictly limited number of technical colleges in which are to be developed technological curricula of a standard comparable with university degree courses. Regional Advisory Councils should be established to coordinate technological studies in universities and technical colleges toward a greater freedom of transfer of undergraduates from technical colleges to universities and a mutual interchange at the post-graduate stage. A further responsibility would be establishment of a few centers of education specializing in certain limited fields such as horology, scientific instruments and rubber technology.

A triple-barreled blast at conventional British higher education is contained in the committee's concluding recommendations that (1) all students of technology should have introductory courses (at least) in what may conveniently be called "management" studies (2) at least one institution should be selected as a center for post-graduate study of industrial administration, and (3) management studies should form a part of the courses not only of universities and colleges of technology but also of all technical colleges teaching for national certificates and diplomas. Further singled out for special attention is the systematization of short or refresher courses in management to be organized by joint effort of teaching profession and industrial specialists.



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CURTAILMENT OF IMPORTS STIMULATED DEVELOPMENT OF CHEMICAL PRODUCTION IN BRAZIL

Special Correspondence

AT PRESENT Brazil's industry is still in the making, yet, since the outbreak of the war it has noticeably expanded. A resolution that met with the President's approval in 1943, favored the idea of constructing power stations which could supply the new chemical-metallurgical plants with inexpensive current.

Before, the war Brazil had been dependent on German imports and, when at the outbreak of the war this stream of supplies was suddenly cut off, the urge for independence grew automatically. Three-quarters of all its chemical imports—in some cases even 90 percent and more—had come from Germany and the latter had conquered the Brazilian market with the aid of long term credits, subsidies and exchange manipulation. After the outbreak of the war, the United States and Great Britain became the main suppliers of chemicals; at the same time Brazil started her own chemical industry, especially an ersatz industry, such as the production of industrial alcohol from sugar cane.

Whether or not the new industries will have a chance to survive will depend on how they will be competitive in quality and price and, furthermore, to which extent Brazil will keep up her customs barriers or, as in the thirties, erect them to protect the domestic industry.

Since the government participated in the

new foundations, it is likely that measures will be taken to protect these young branches of industry. The great steel mills of Volta Redonda, which are going to start production this year, have been constructed by a national steel company that is affiliated with the government. In connection with steel production a series of essential chemical byproducts will appear on the market. Furthermore, the government also took part in the foundation of the national alkali company for the production of caustic soda and similar products on which Brazil had been entirely dependent upon imports.

Due to the lack of some special machines and raw material, expansion of the chemical production was limited during the war. As soon as conditions improve these young branches of industry will expand. The textile industry with its 500 factories and the leather industry, both with a great demand of chemicals, have grown considerably. The textile industry produces mainly cotton goods, but also other fabrics such as silk, rayon, linen, woolen fabrics and burlap. The government distributed among the silk industry selected cocoons and mulberry sprouts.

Great progress also is to be noticed in production of paper and cellulose. A variety of domestic products such as pine-wood, rice-straw and fiber is being used. In Southern Brazil 167 cellulose factories are work-

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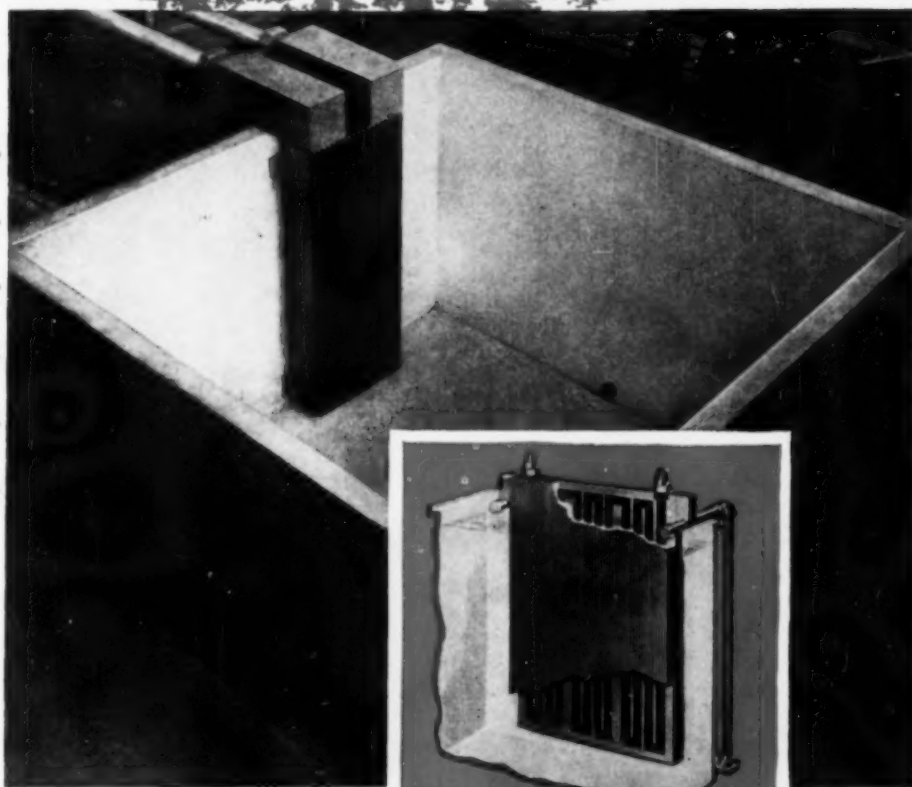
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September 12, 1945

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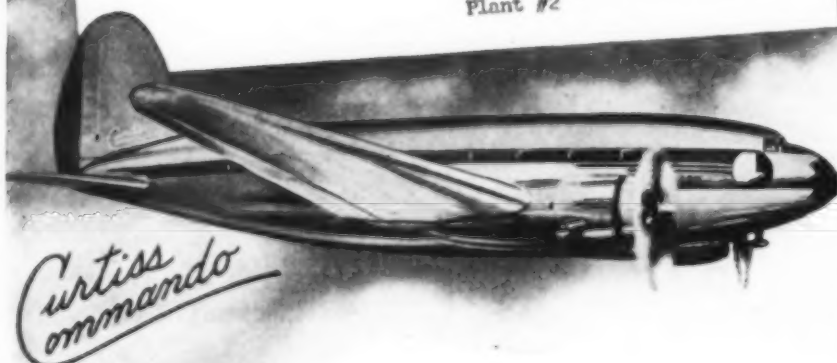
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ing now, and 109 more are being built. The Companhia Industria Reunidas Matarazzo has started with the production of cellophane.

As to explosives, details are not known. Yet, the industrialization of the country, the building of roads, railroads, and power stations and the increased exploitation of mines automatically bring about an increase in the use of dynamite the production of which is partly in the hands of the ministry of war and partly in private industry.

In general the synthetic industry of organic chemistry is still in its beginning except for the winning of byproducts and the production of gas. To a small extent, textile colors are produced from imported raw material. With the growth of the textile industry the demand of coal tar colors has reached the value of \$4,000,000 which had been almost exclusively imported from Germany before the war; even domestic stocks were in the hands of companies under German control. However, by 1943 the United States, Great Britain and to a small extent, Switzerland were supplying the Brazilian market.

Great changes, have taken place in the plastic industry where the diminishing imports of important material led to the development of domestic production. Thus casein resin and ebonite are gained from domestic material. Synthetic resin is mostly imported.

In the field of industrial chemicals the government plans to subsidize the manufacture of caustic soda which would make Brazil almost independent of imports. Among other products, sulphuric acid is being derived from iron ore in a plant in Piquete which is owned by the government. Through exploitation of existing plants and the building of four new plants production is going to be increased tremendously.

Brazil shows a large consumption of medicines per capita. The market is protected by high import duties. After the outbreak of the war the government took over all well known German laboratories. It plans to eliminate private industry in this field. Brazil has been successful in the export of pharmaceutical and medical products, especially to other Latin-American countries; to the United States, mostly caffeine and theabronine were exported.

Foreign Trade in Chemicals

\$1,000

	1939	1944
Import		
Total	27,000	38,000
Out of this amount:		
Industrial chemicals	10,900	19,500
Fertilizer	1,500	1,300
Coal-tar and other organic chemical products	4,000	7,100
Export		
Total	10,300	23,400
Out of this amount:		
Oil, wax, resins	8,500	16,700
Medicines, pharmaceuticals	100	3,400

High import duties make it possible for the considerable demand for perfume, soap and other cosmetics to be met by Brazil's own production. American and European producers, thus cut off from the market were stimulated to open up subsidiaries. American companies show keen interest in establishing factories for the production of wax and vegetable oil in north and northeastern Brazil. Another American proj-

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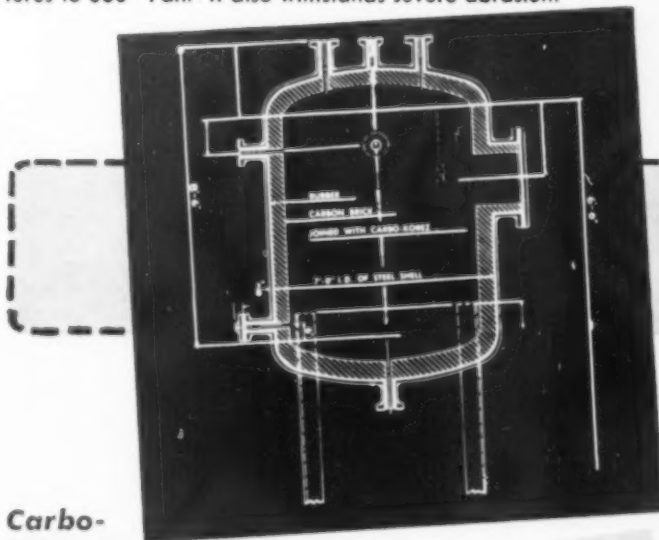
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ect that deserves to be noticed—since lumber is gaining momentum in the chemical industry—is the construction of a big plant in Parana for the processing of lumber. Universities and technological institutes of the United States assist in working out plans to establish a school for industrial chemistry in Sao Paulo. Thus, through American and other foreign aid, countermeasures are being taken to remedy Brazil's lack of capital and of technical experience.

The participation of the State and the interest of the government in industrializing the country and especially the chemical industry may result in Brazil's taking over Germany's inheritance on the Latin-American continent.

Some New Chemical Plants

Industria Chimica Iguassu, S.A.	magnesium and calcium sulphate
Co. Nacional de Alcalis	caustic soda
Establecimientos Animicos	nitrocellulose lacquer
Sintecol, S.A.	butyl alcohol
S.A. do Gaz, Rio	gasoline and coal-tar products
Co. Eletro Chimica Brasileira	explosives materials
Soc. Commercial de Foforos, Ltda.	matches
Co. Vidreira do Brasil	glass
C. Industrias Reunidas Matarazzo	cellophane
Co. Nitro-Quimica Brasileira	nitrocellulose, rayon
Duperial do Brasil	caustic soda
Perfumerias Flebo Ltda.	plastic containers for cosmetics

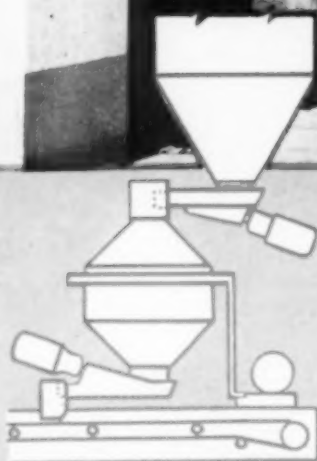
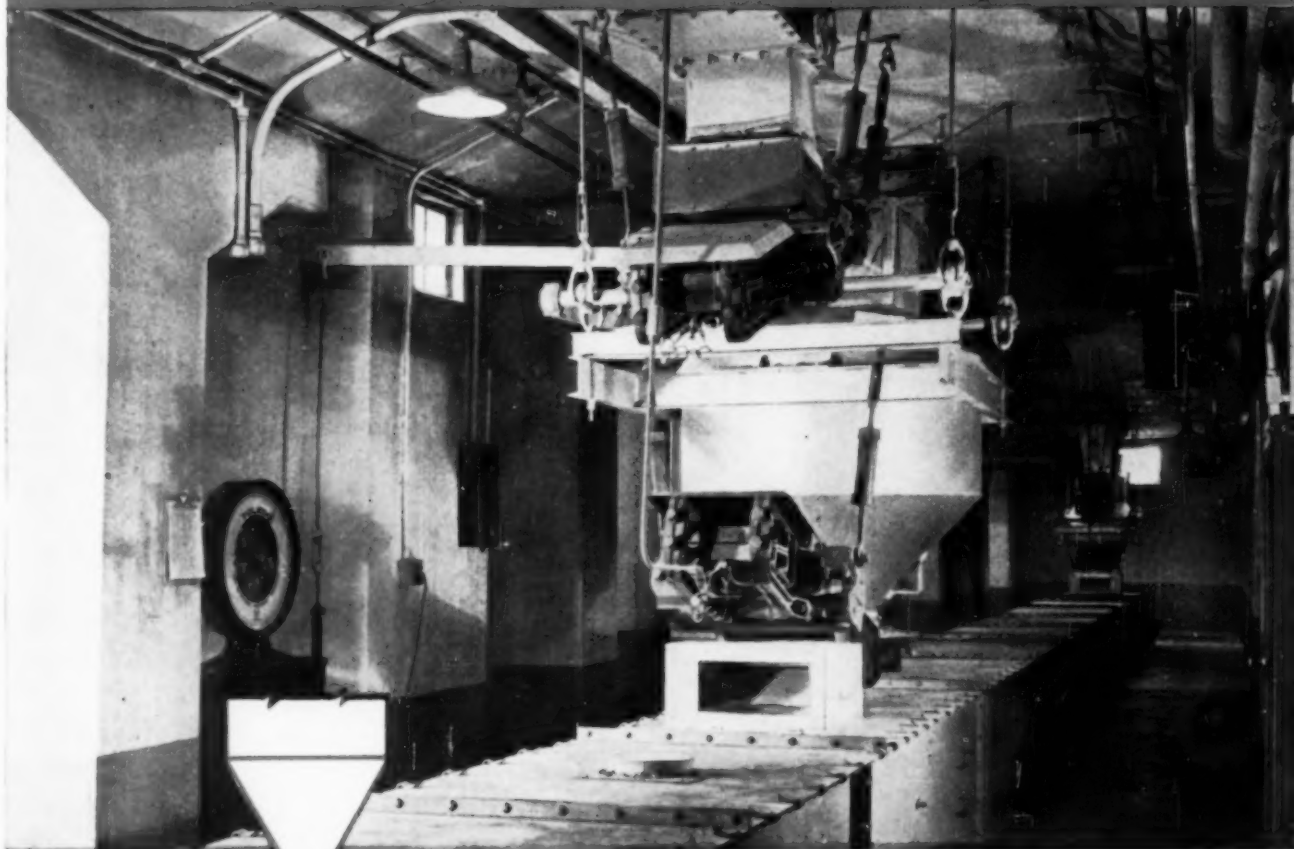
PHOSPHATE ROCK MINING IN FRENCH MOROCCO

WHILE latest reports on phosphate rock production in French Morocco indicate that the output continues below the anticipated monthly level, some improvement has been made recently. The main difficulty is shortage of electric power which has restricted extraction of the rock and its drying and transport. The improvement has come about by shifting production as much as possible from Khouribga to Louis Gentil and by bringing the rates of extraction and drying at the former more nearly into balance. It requires about 10 kwh. to produce a ton of dry phosphate at Khouribga and ship it by electric railway to Casablanca whereas it takes only 4.5 kwh. to produce a ton at Louis Gentil and send it by steam railway to Safi.

PALESTINE INCREASES OUTPUT OF INDUSTRIAL CHEMICALS

THROUGHOUT the war period, production of chemicals in Palestine was on an upward trend. The cutting off of many import sources forced production at home of the missing chemicals or of others which might be substituted. Expansion was particularly notable in the field of industrial chemicals and the enlarged outputs enabled the country to export to a value of £500,000 during the first half

AUTOMATIC BATCHING



In this type of Jeffrey-Traylor Electric Vibrator installation, charging feeders controlled by a scale weigh and batch any number of ingredients. (Patented)

If desired, this equipment can be designed to furnish printed record of weights of individual ingredients as well as the collective batch.



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▲ **9:17:05 A.M. . . .** In just 65 seconds, this tough overhead gasoline fire (including blaze on ground) is OUT.



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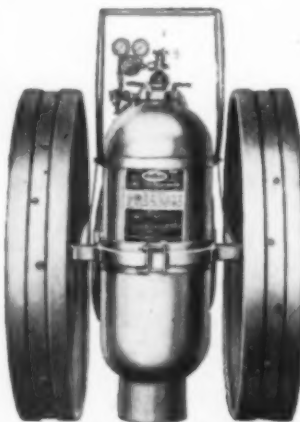
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of 1945. The Palestine Potash Co. using chemical materials from the Dead Sea was the pioneer in the country's prewar industry. About 60 industrial chemicals are now produced in Palestine. These consist largely in supplying chemicals for textile, leather, and dyeing; materials for paint; and chemicals required by the fermentation branch. Postwar planning calls for a new sulphuric acid plant with a capacity of 50 tons a day. It is possible that production of caustic soda will be attempted.

ALUMINUM PRODUCTION AT LOW LEVEL IN NORWAY

THE prewar Norwegian aluminum industry consisted of five smelters and a plant for the production of alumina and pig aluminum. The Germans, during their occupation, kept these plants intact and started construction on seven new plants. None of these, however, was completed. Scarcity of raw materials and sabotage cut production in the operating plants and when the Germans withdrew, production ceased altogether. One plant which had a stockpile of alumina began to operate in July but latest reports credit the other plants as remaining idle and current production is not sufficient for domestic needs.

RUBBER SUPPLIES FROM THE AMERICAN REPUBLICS

UNDER agreements with the United States, 15 other American countries increased their efforts to expand production of natural rubber during the war years and these republics supplied the United States with more than 17 percent of its rubber imports from 1942 through the first half of 1945. Including latex, crude and guayule rubber, the republics sent 92,000 long tons to the United States with Brazil and Mexico as the most important shippers.

CANADIAN RAYON WEAVERS FORM ASSOCIATION

RAYON textile interests in Quebec, Canada, have formed the Silk & Rayon Manufacturers Association with headquarters in Montreal. This move was taken to bring the mills together to facilitate the transition from war to peacetime production. In addition the association will serve as a clearing house for interchange of ideas on all problems confronting the industry. One of the first subjects to occupy attention is connected with the possibility of expanding export trade. Labor shortages and labor relations also will be considered and a permanent labor relations director has been appointed. The president of the new association is J. L. Hodges, president of British American Silk Mills, Ltd.

GREAT BRITAIN RELEASES CADMIUM FOR EXPORT

UNOFFICIAL reports from Great Britain say that about 50 tons of cadmium have been released to manufacturers for the production of cadmium pigments for export. This supply is said to cover export

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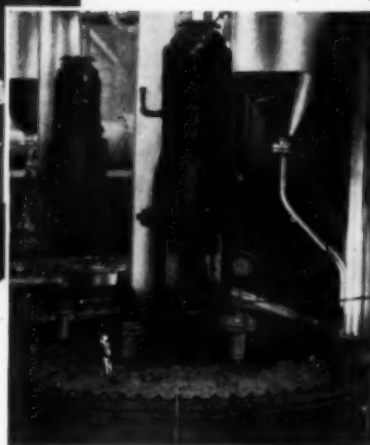
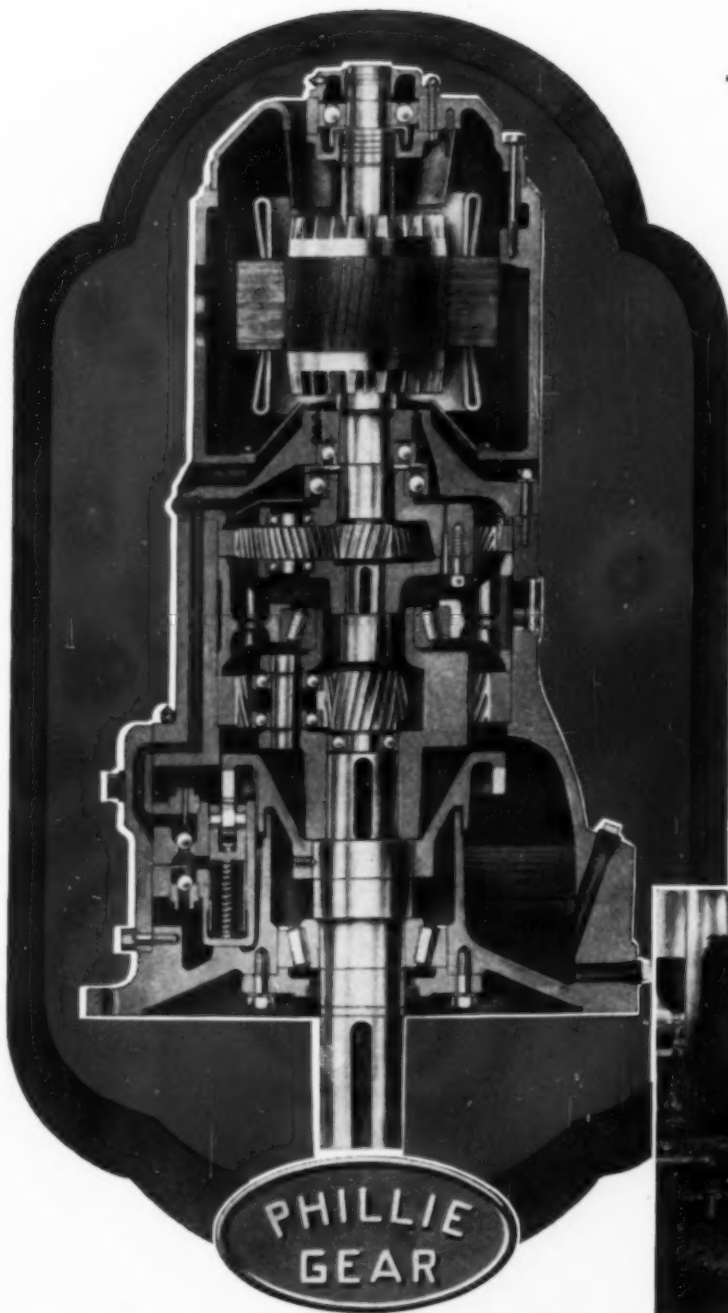
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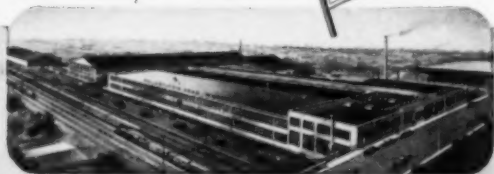
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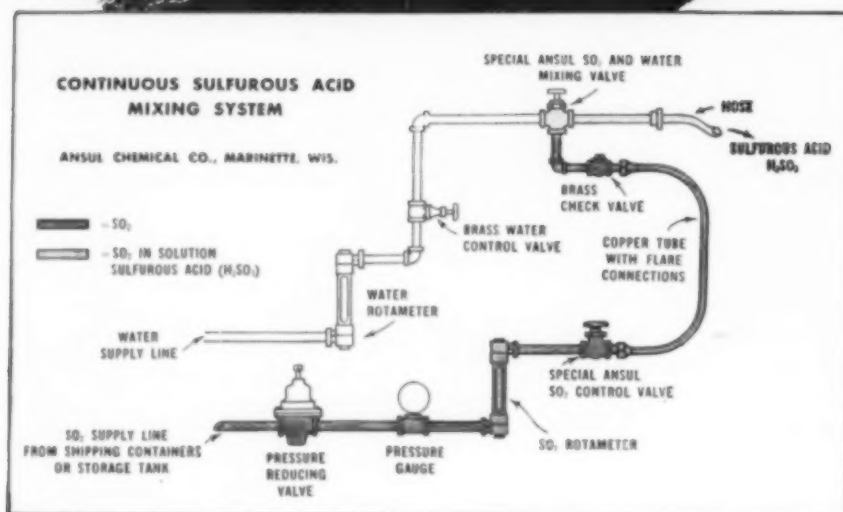
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Boiling point.....	14.0° F. (-10.0° C.)
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Specific gravity at 80° F.....	1.363
Density of gas at 0° C. and 760 mm.....	2.9267 grams per liter (0.1827 lb. per cu. ft.)
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requirements through next June. The reports further state that a portion of this allotment may be used by United Kingdom manufacturers to turn out finished products for export.

CANADIAN MILL SHIPS NYLON YARN FOR CIVILIAN USE

WHAT is described as the first nylon yarn made in Canada to be made available for civilian use was shipped to a hosiery mill in October. The plant making the yarn is located in Kingston, Ontario, and has been in operation since July 1942. Until recently its entire output had been used for military requirements for parachutes, glider tow ropes, and ponchos. Prior to the war, nylon hosiery was made in Canada from imported yarn.

SCARCITY OF PULPWOOD IN SWITZERLAND

A COOPERATIVE enterprise at Lucerne, Switzerland, acts as a central agency for procuring pulpwood for all the pulp mills in that country. It arranges and executes pulpwood contracts, supervises preparation of the wood, and makes shipments to the mills. At present it is having difficulty in getting enough wood because so much of the timber is being used for fuel. Some of the largest pulp mills are threatened with a temporary shut-down unless pulpwood can be imported from neighboring countries.

INDIA INCREASES IMPORTS OF CHEMICALS AND DRUGS

IMPORTS of chemicals and drugs into India increased almost 50 percent in value in 1944-45 compared with the preceding fiscal year according to official customs statistics. Comparable figures are given as 101,415,942 and 68,568,541 rupees respectively or approximately \$30,547,000 and \$20,654,000. Dyes did not share in the general trend as there was a falling off in imports.

SOVIET UNION PRODUCES HIGH-GRADE CLAY

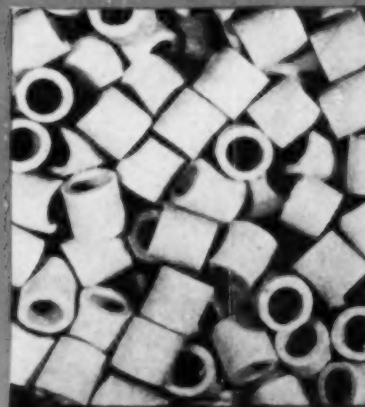
PRODUCTION of a high-grade of china clay has been resumed in Dniepropetrovsk, Soviet Russia. The plant was destroyed during the German occupation but work of restoring it began some months ago and it was reported that a good part of the work had been completed by last September. This section is said to contain some of the finest kaolin deposits in the Soviet Union.

WAX SHORTAGE CUTS CANDLE PRODUCTION IN EIRE

BECAUSE paraffin wax is in such short supply, manufacturers in Eire have been forced to discontinue temporarily, the production of shrine candles for churches. Kerosene oil is being rationed and a large part of the rural population is largely dependent upon candles for lighting. Imports of wax have been reduced so they cover only about one-third of the country's requirements.



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CONTINUOUS NITRATION PROCESS FOR TNT

THE SCHELBUSCH factory of Dynamit A.G. is 20 miles north of Troisdorf. During discussion with people at Troisdorf, it was mentioned that there was a continuous process for TNT manufacture at Schelbusch. The plant was an experimental one and had not been operating as a production unit although quantities of TNT had been made and the optimum operating conditions were being sought.

The process of nitration was carried out continuously in five nitrators and four separators arranged on an incline to permit of gravity flow from vessel to vessel. All vessels were fabricated in cast iron and were lagged with glass wool. Approximate dimensions of the nitrators was 3 ft. diam. by 4 ft. high and the separators were approximately 4 ft. in diam. by 2 ft. in depth. The separators were fitted with glass inspection windows to show the interface between acid and nitrobody. There was no sign of acid leakage from these window joints. The outlet from the nitrators was located about 1 ft. from the top of the vessel and consisted of lead pipe of 1½-in. diam. From the bottom of each separator a pipeline ran to acid tanks on a lower floor and a similar outlet from the liquid level in the separator ran to each succeeding nitrator.

Purification of the TNT by washing and sulphiting was also done by a continuous process, the plant consisting of four wash-

ers and four separators. As in the nitration plant the vessels were arranged on an incline to permit of gravity flow. The vessels appeared to be fabricated in stainless steel and lagged with glass wool.

The washers were approximately 2½-ft. diam. and 3 ft. high. The separators were approximately 3 ft. in diam. and 1½-ft. high. The first washer was used for removing acidity by water washing, the second washer was used for the sulphite treatment and the remaining two washers were again water washing ones.

The TNT nitration plant is of interest as an application of ordinary batch nitrating procedure to continuous plant and formed a very neat and compact unit.

TETRAETHYL LEAD

THE FROSE plant was visited on May 12, 1945. It is the property of the IG, and was put into operation in August 1939, primarily for the production of tetraethyl lead and ethyl fluid. It operated continuously from August 1939 to April 12, 1945. It is entirely undamaged and in condition to operate again as soon as raw materials are available.

Three hundred tons (metric) per month of tetraethyl lead were made at the Frose plant, using the process of the Ethyl Gasoline Corp.

The alloy was made by the batch process, 2,700 kg. of PbNa (Na content, 9.98-10.00 percent; Mg, 0.1 percent) being made

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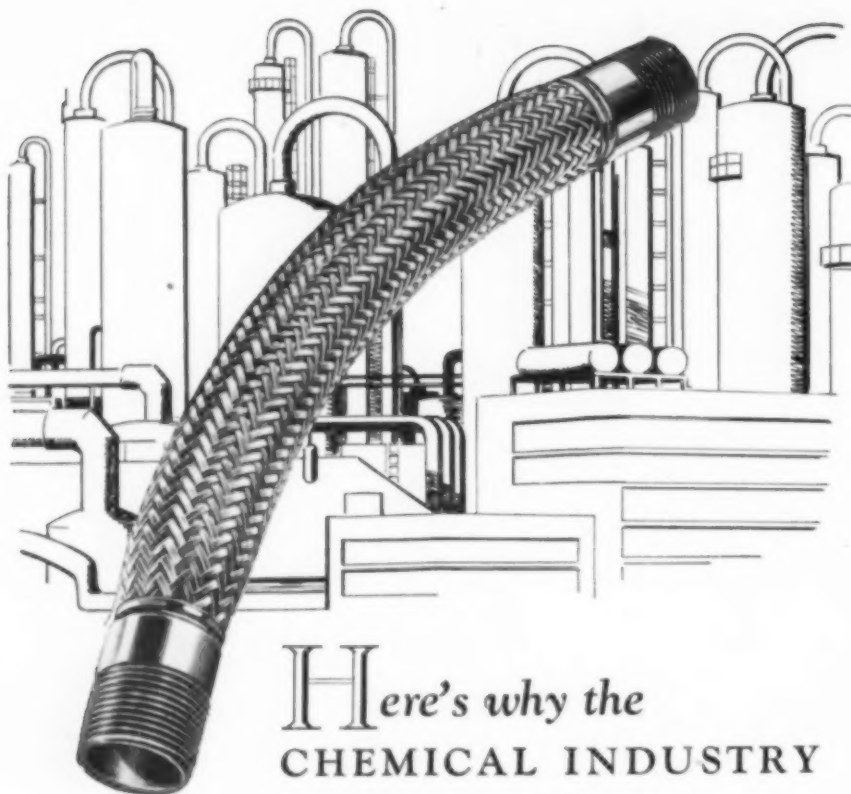
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in each lot. This was cast in conical molds (cast iron), cooled under heavy oil, crushed and put into the charging hoppers.

One half of each batch of alloy, or 1,350 kg. was used as an autoclave charge, and was ethylated with 590 kg. of ethyl chloride (of which 200 kg. were recovered) to give 390-400 kg. of tetraethyl lead, a yield (on sodium) of 81.5-84.0 percent of theory.

Soluble cutting oil, purchased, was used as a lead dispersing agent in the still. The emulsifying agent was originally Turkey Red oil, but later, as castor oil became scarce, resin acid scraps were substituted.

The autoclave reaction time, from charging to charging, was 8 hr.

Bismuth was removed by blowing the tetraethyl lead with air, settling, and then filtering. The bismuth residues were worked up for metallic bismuth, but the production was only 50.75 kg. per month.

METHYL METHACRYLATE

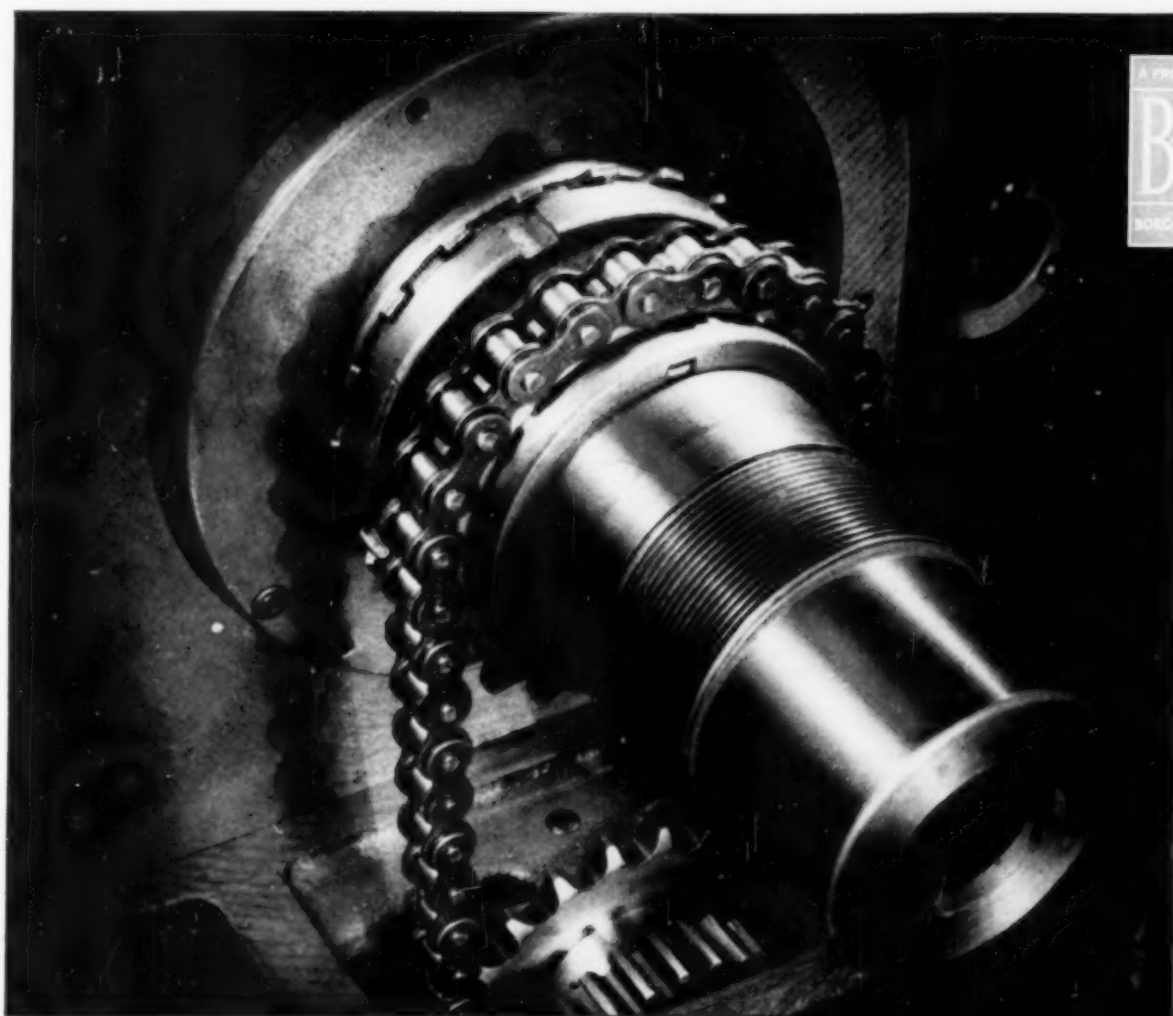
The Rohm and Haas plant at Darmstadt as a whole is quite badly damaged; however, some power generating facilities are available and the unit for the production of methyl methacrylate monomer is essentially intact. The plant products may be divided into two classifications, enzymatic products which are of no military importance and likely have little further economic promise, and the Plexiglas materials (polymerized methyl methacrylate) which were quite important to the German war effort.

Methyl methacrylate monomer was prepared from acetone cyanhydrin. One mol of acetone cyanhydrin (98 percent pure) was charged to an enamelled tank and 1.55 mols of concentrated sulphuric acid were then added slowly during a period of about 30 min. keeping the temperature at 60 deg. C. A sirupy mass resulted. As soon as all of the acid had been added the mixture was heated quickly, (20-25 min. cycle) to 128 deg. C. in order to complete the formation of methyl acrylamide.

The amide product was then transferred to the esterifier, a brick-lined steel vessel of 1,500-gal. capacity equipped with a turbine type stirrer of silicon iron construction. Next 1.8 mols of methanol were added followed by water which was added at such a rate that the heat of dilution plus the heat of reaction was sufficient to maintain the batch temperature at 80 deg. C. Cooling was accomplished by refluxing methanol at the start of the reaction. During the 1 to $1\frac{1}{2}$ hr. operating cycle the esterification and hydrolysis reactions took place simultaneously to yield methyl methacrylate and dilute sulphuric acid.

The reaction mixture was then dropped to a brick-lined steel tank and live steam was added to strip the volatiles from the sulphuric acid-ammonium sulphate residue. The distillate separated into an upper layer containing about 95 percent methyl methacrylate plus water and methanol and a lower layer of methanol and water plus a trace of monomer. The lower layer was distilled batchwise to recover in order, monomer, dilute methanol which was recycled, and a water residue which was discarded.

The upper layer was mixed with inhibitor using about 0.025 parts phenol per part of monomer and then distilled continuously in bubble cap stills of aluminum construction, with the exception that the reboiler



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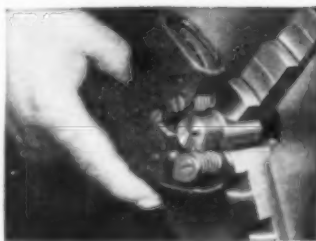
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AA-59

of the second still which was steel. The first column removed all the low boilers overhead. This product was washed with water, the upper monomer layer was recycled and the lower water layer was discarded. The second continuous column, operating at about 300 mm. delivered pure monomer. Experience had shown that high purity monomer was necessary for the production of a quality polymer. Therefore, a minimum purity of 99.9 percent was specified.

The residue from the monomer still containing phenol plus polymer was cracked at 350 deg. C. in an electrically heated steel still. This unit, operating at atmospheric pressure, was equipped with a slow speed scraper type stirrer. Feed was semi-continuous. The monomer and the phenol together with monomer formed by depolymerization distilled off leaving a carbon residue which was collected in a sump at the discharge end of the still. The overhead was recycled to the monomer purification system and the coke residue was removed periodically.

Finished monomer was stored in aluminum tanks maintained at 0 to 2 deg. C. A nitrogen atmosphere was not essential and storage for a period as long as 5 mo. was not harmful.

The factory yield on pure ethylene cyanhydrin charged was 85 percent of theory as compared with a laboratory yield of 92 percent.

HYDRAZINE HYDRATE

HYDROGEN PEROXIDE is most efficiently utilized for propulsive purposes when it reacts directly with another substance. Its simple decomposition by catalysis is wasteful because it discards oxygen that might be used to better purposes. A satisfactory direct interaction of hydrogen peroxide with such another substance (or substances) is not easy to obtain. The Germans have succeeded in solving this problem practically, by the use of hydrazine hydrate as an adjunct to the combustion process. Hydrazine hydrate rather than hydrazine, is used because the hydrate is much easier to make.

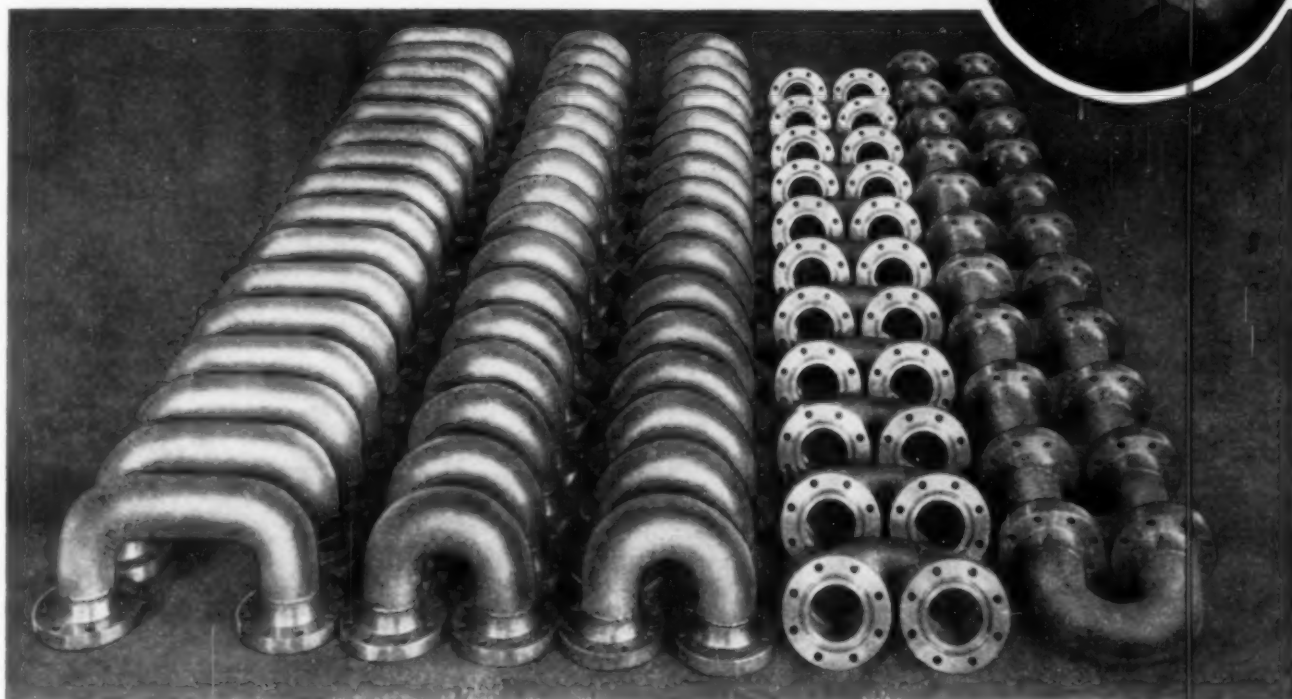
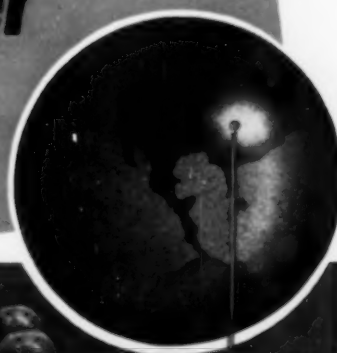
The process of manufacture is as follows: NaOCl is mixed with copper and albumen catalysts and is treated with 25 percent ammonia under a pressure of 30-40 atm. The mixture, at 25 deg. C., then passes rapidly (1-1.5 sec.) through a long thin heated tube and emerges at a temperature of 160-180 deg. C. The pressure is then immediately released and the bulk of the excess ammonia passes off and is recovered. The reaction mixture which now contains about 3 percent of hydrazine is passed down a Raschig column where it is vaporized. The residual ammonia is removed and the hydrazine passes over with the water, leaving the sodium chloride behind. The hydrazine is then concentrated by successive fractionation.

The yield in the distillation, based on the amount of crude solution employed, is 80-85 percent. The sources of loss are: oxidation by air, loss during removal of NaCl, catalytic decomposition, and losses in run-off condensate.

Concentrated $\text{NH}_2\text{NH}_2\cdot\text{H}_2\text{O}$ vapors are a little known blood poison; it is therefore necessary to take great pains to avoid leaks in the apparatus and to provide good ventilation for the room in which the apparatus is located. Moreover, the solution and

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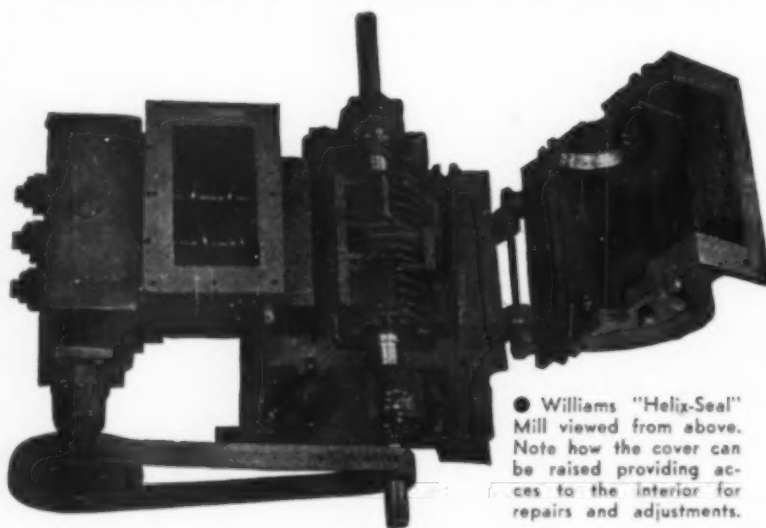
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vapors of $\text{NH}_4\text{NH}_2\cdot\text{H}_2\text{O}$ act as a skin-poison, depending somewhat on the individual. It is especially important to protect the eyes from spray or mist of the solution.

PREPARATION OF ARTIFICIAL TANNING MATERIALS

TANIGANS are artificial tanning materials for leather. Tanigan Extra A is a mixture of dioxydiphenylsulfone and dioxydiphenylsulfone-formaldehyde resin in sulphite liquor.

Preparation of the sulphite liquor: Raw calcium bisulphite waste liquor from the Aschaffenburg Cellulose works in Walsum is treated with 50 percent NaOH solution at 50 deg. C. to a pH 8.6 and then at 55 deg. C. with caustic soda till no further precipitation of lime occurs and an alkali number of 15-30 results. The mixture is stirred $\frac{1}{2}$ hr., filtered, and the liquor settled for 12 hr. until the calcium content is under 0.1 percent, when it is concentrated to 32 deg. B. (solid content 53 percent).

Preparation of 4,4'-dioxydiphenylsulfone: 1,600 l. of H_2SO_4 monohydrate is run into 9,400 l. of crude phenol at 65 deg. C. in 3 hr. and heated under lowered pressure to 150 deg. C. distilling off excess phenol and water over 30 hr. for a total distillate of 5,000 l. The batch is neutralized and dissolved in 520 l. of 50 percent NaOH and 2,600 l. water under pressure.

Preparation of the resin: 11,600 l. of 32 deg. C. sulphite liquor and 800 l. of the above sulfone liquor are stirred together at 110 deg. C. and adjusted to an alkali number of 4.0. At 65 deg. C. the necessary formaldehyde is added in 20 min. The mass is heated to 105 deg. C. till the condensation is complete. Roughly for 100 kg. sulfone, 60 l. for formaldehyde is used. The yield is 4.4 to 4.8 times the amount of phenol used.

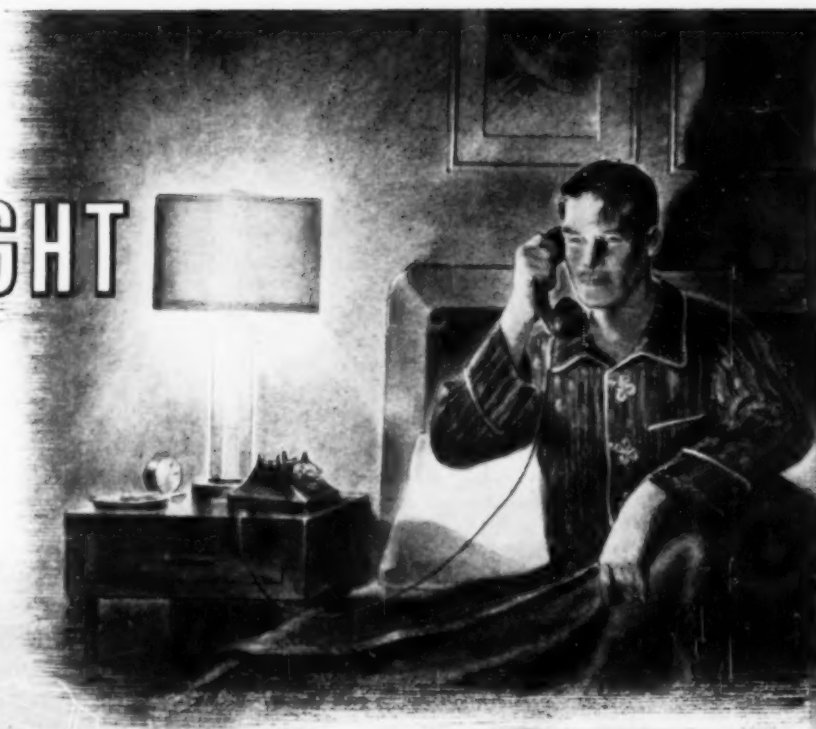
HEXYL ALCOHOLS

BOTH n- and iso-hexylalcohols were produced by treating a mixture of acetaldehyde and butyraldehyde with dilute sodium hydroxide under carefully controlled conditions and subsequently hydrogenizing the distilled unsaturated aldehydes in the presence of a copper catalyst, followed by separation of the hexylalcohols under vacuum. The complete process is as follows:

Into the aldol boiler (iron) a mixture of acetaldehyde and butyraldehyde flows continuously in the proportion of 5:1. At the same time, 5 percent of a solution of 2N-NaOH is added based on the mixed aldehydes. The temperature is kept between 6 and 14 deg. and circulated with a pump for 5 hr. after which the mixture runs out of the after reaction system with an addition of excess acetic acid amounting to 20 g. per l. The acid mixture flows into a storage tank and is then drawn as required for discontinuous distillation under normal pressure in copper stills, 10 percent of water is added and the acetaldehyde is fractionated. Subsequently, the remaining unsaturated C_4 , C_5 , C_6 aldehydes are separated by steam distillation and the condensed water returned. When the operation is completed the waste water is drained off. The unsaturated C_4 , C_5 , C_6 aldehydes are then hydrogenated by circulation with excess hydrogen at a temperature between 190 and 210 deg. in the

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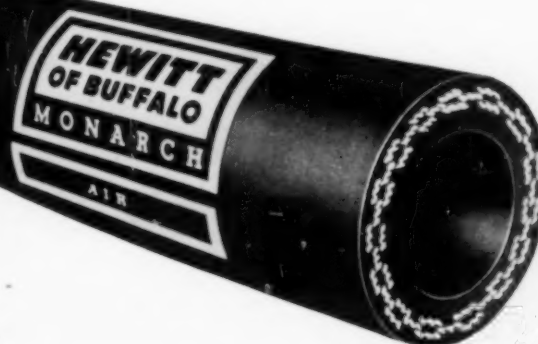
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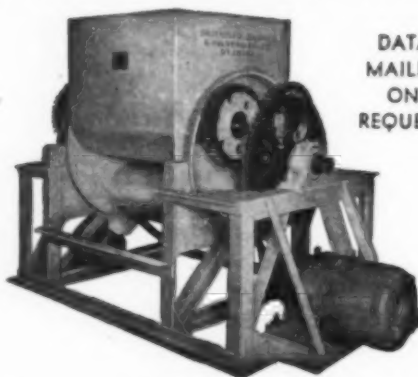
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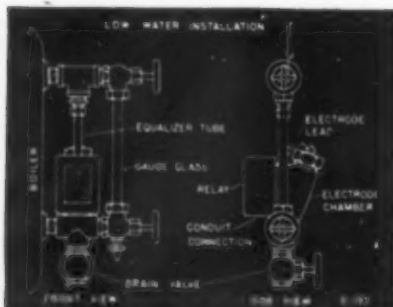
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presence of a reduced copper catalyst laid on pumice. Out of the circulation gas the alcohols are condensed and separated with 20 percent of the higher alcohols remaining as residue. The higher alcohols are then separated under vacuum of 20 to 30 mm. Hg. The ratio of n-hexyl to iso-hexylalcohol is about 14:5 and that of the C₄ to C₅ alcohols about 9:1.

The hexylalcohols are used for the preparation of acids, pharmaceuticals and plasticizers.

ACETYLENE BY THE ARC PROCESS

THE ACETYLENE plant at Chemische Werke Huls was designed to operate on a gas from the Scholven hydrogenation works, containing 70 percent methane, 25 percent ethane and 5 percent propane. Due to the bombing of the Scholven works, natural gas containing 90 percent methane, 2 percent ethane, 8 percent nitrogen, with some H₂S and CO₂ was substituted as feed stock.

The gas is purified to remove H₂S with Alkacid and sodium hydroxide. The gas, under a few inches of water pressure, is then passed through an iron arc. The gas from the arc has the following percentage composition:

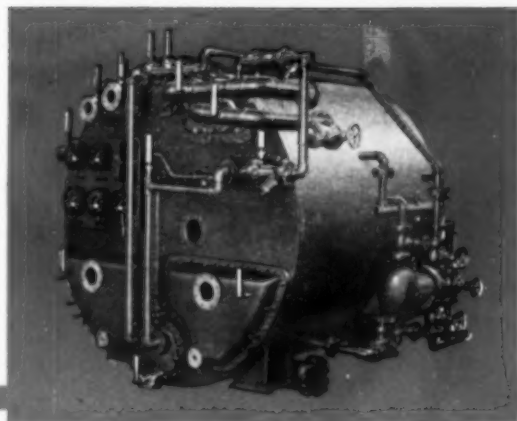
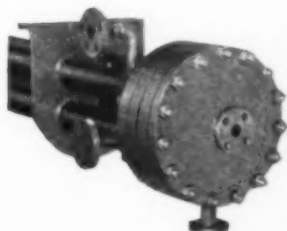
Carbon monoxide	0.9
Oxygen	0.2
Acetylene	16.8
Ethylene	3.9
Paraffins, mostly CH ₄	24.9
Hydrogen	50.7
Nitrogen	2.6

The gas at the outlet of the arc is cooled to 150 deg. C. by direct water injection and passes to a second water contacting tower. The carbon black produced is removed by cyclone separators and bag filters. The tar polymers are removed by an oil scrubber using a low temperature tar oil; the HCN is then removed by water washing and the H₂S then removed by a luxmasse (Fe₂O₃) treatment. The gas is then stored in a gas holder for charge to the acetylene separation plant.

The gas mixture is compressed to 18 atm. in four stages with interstage cooling to prevent excessive heating which would cause explosion difficulties, and then contacted with water. The acetylene is dissolved in the water under these conditions, and then is flashed from the water in four stages. In the first stage, the water is flashed to 2 atm. pressure where a gas containing the absorbed hydrocarbons and some acetylene is removed and recycled to the suction of the compressors. In the second stage, the water is flashed to atmospheric pressure and a 93 percent pure acetylene obtained. In the third and fourth stages the water is flashed to 80 percent and 95 percent vacuum respectively. The acetylene mixture from the three final stages contains 95-96 percent acetylene, the remainder being hydrogen, nitrogen and ethane.

Unabsorbed gas from the water contactor contains 55 percent hydrogen, 20-35 percent total hydrocarbon, including 3-5 percent of ethylene, and 8-10 percent nitrogen with a small amount of carbon monoxide. This gas is processed in two Linde units for the production of pure hydrogen and ethylene. In the first Linde unit, the gas, under 17 atm. pressure, is separated into three streams: ethane-ethylene, methane, and hydrogen. A temperature of 205 deg. C. is obtained for the separation of the hydro-

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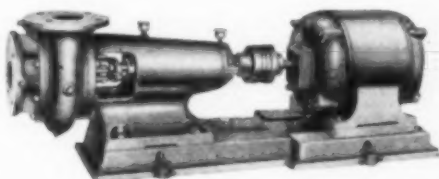
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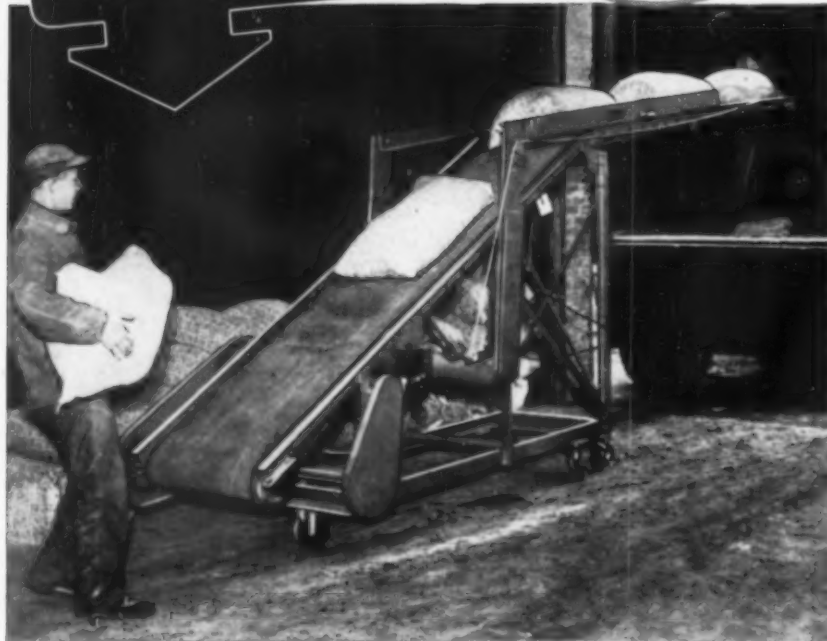
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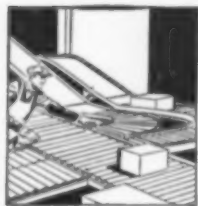
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gen from the methane by boiling pure nitrogen under vacuum. The hydrogen stream containing 0.0001 percent CO and 98.99 percent hydrogen is used for the hydrogenation of acetylene to ethylene. The methane stream is returned to the arc unit. The ethane-ethylene stream is charged to a second Linde unit where pure ethylene is separated. The ethane is returned to the arc unit.

The natural gas consumption is 120,000 tons per year. Each 100 kg. of raw gas produces 45 kg. of acetylene, 9.2 kg. of ethylene, 5.3 kg. of carbon black and 142.5 cu.m. of pure hydrogen.

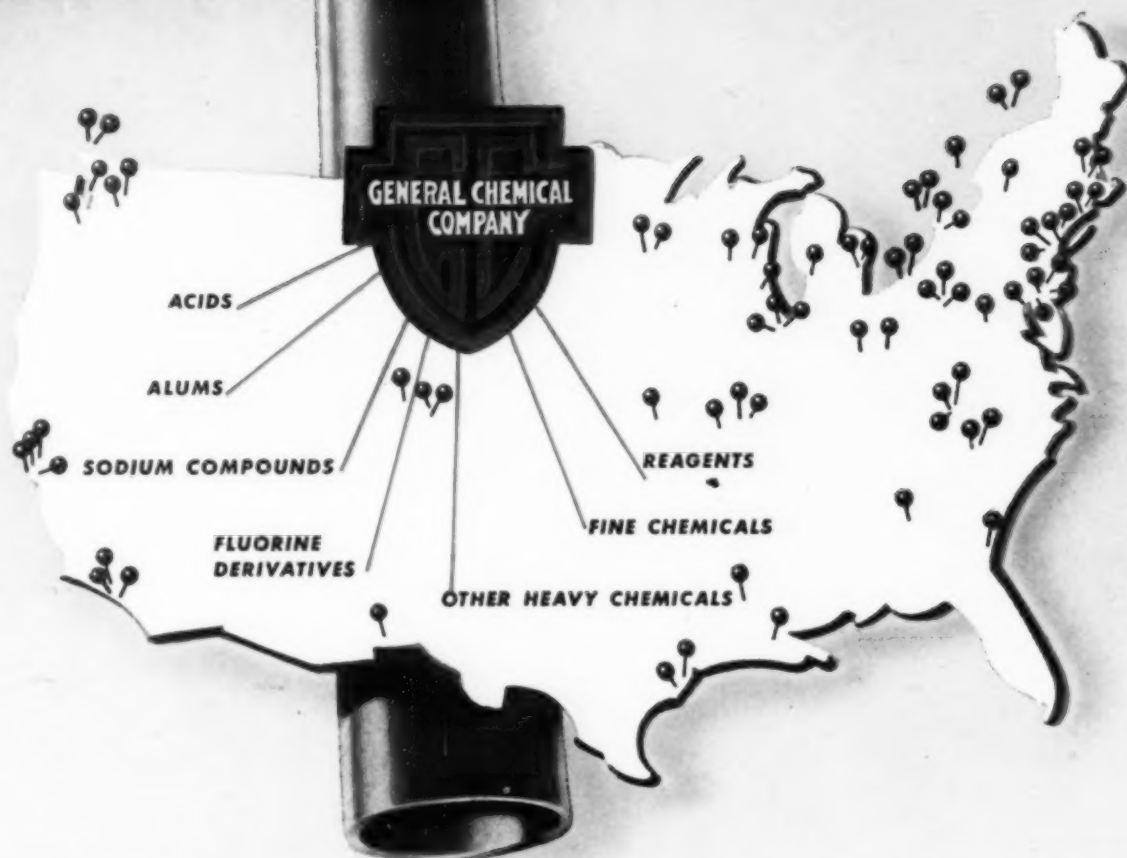
The plant consists of 14 arcs with 12 arcs running at any one time. One arc consumes 7,000 kw. and produces 700-800 kg. of acetylene per hr.

The gas enters the upper section of the arc through a tangential arrangement to produce a swirling motion in the arc tube proper so that the arc will not remain at one point for sufficient time to burn through the tube. The arc tube proper is an iron pipe of 90 mm. inside diameter and 1 m. in length. A water jacket is provided around this tube to prevent excessive burning of the tube. The arc is struck by a starting mechanism which is immediately withdrawn. The iron arc tube has a life of 150 hr. and then is removed and discarded. It is necessary to shut down the arc every 1-3 days for cleaning out the carbon black. Two arcs are used in connection with one water-washing system in order that the arc tube can be cleaned or changed without materially affecting the output of the plant.

HEXAMETHYLENETETRAMINE

THE RAW materials are pumped separately through their own rotameters, in proportion of 3,050 kg. of 27 percent aqua NH₃ to 6,000 kg. of 30 percent formaldehyde, to the mixing chamber. The material is sent from the mixer to the evaporator with 3 compartments containing tube bundles. The dilute solution from the mixer is flowed to the first compartment, and by overflow to the second compartment and by overflow again to the third compartment. The concentrated solution (40 percent solids) is then flowed to a vacuum (150 mm.) evaporator with stirrer in well of tube sheet and with tubes around the circumference. The solution temperature was 60 to 70 deg. C. A vacuum was maintained with a pump and the condensate discharged through a barometric leg. The slurry from the evaporator is discharged to a continuous centrifuge where the hexamine is dried to 5 percent H₂O. There were four such evaporators operated batchwise so that the mixer and concentrator were kept in continuous operation by rotating from one evaporator to another. There were two continuous centrifuges, each with its own steam jacketed dryer. The dryer agitated the product by a rotating screw similar to a screw conveyor. The hexamine containing 5 percent was discharged into the dryers described above where the steam jacket maintained a temperature of 105 deg. C. inside of the dryer. The hexamine was put through a crusher and screened to size with oversize lumps returned to the crusher. The product (99.9 percent hexamine) was bagged as made into 100 kg. bags with a weighing device on the end of the dryer after the crusher. The

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mother liquor from the centrifuge was run to a stirring kettle, diluted with water, and charcoal was added to remove the color. The solution was then allowed to settle and the clear liquor pumped back to the concentrator for reprocessing.

THE FISCHER-TROPSCH PROCESS

In the first few days of March 1945 a Fischer-Tropsch plant at Moers and a hydrogenation plant at Wesseling were captured and opened for investigation. An I. G. Farbenindustrie plant at Ludwigshafen was captured on March 23.

Since the synthetic oil industry was the basis for most of the military and civilian transportation, it received a great deal of attention from the Allied bombers. German synthetic production reached a peak of somewhat over 350,000 metric tons per month in 1944.

The first Fischer-Tropsch plant investigated was at Moers, a small town east of Krefeld, on the west bank of the Rhine. All other Fischer-Tropsch plants were in the Ruhr (exclusive of those which may exist in the areas seized by the Russians) with the exception of a commercial plant at Lutzkendorf and one small pilot plant near Leipzig. Information on plant operations was not difficult to secure.

All Fischer-Tropsch plants in Germany operated by essentially the same process, with only minor variations. In fact, no Fischer-Tropsch plant has been built since 1938, a decision which hinged apparently on the German conviction that they would be able to seize other sources of oil, and did not need to expend additional funds, manpower, and material for synthetic oil plants.

Synthesis gas for the plants was made almost universally by the water-gas reaction, using coke. Experimental work using brown coal as raw material was being tried in the Leipzig area. Purification of the gases was carried out in two steps using iron oxide catalysts to remove H₂S and iron oxide catalysts treated with sodium carbonate to remove organic sulphur. In the latter case a small amount of oxygen was bled into the gas before purification was attempted. The ratio of hydrogen to carbon monoxide was balanced by the use of a shift converter to react CO and water to produce hydrogen on by means of cracking coke-oven gas thermally or catalytically. Where coke-oven gas was used, an active carbon adsorption system was frequently necessary to remove resinous material. This step generally preceded passage of the gas to the organic sulphur removal equipment.

At Moers the plant contains three batteries of coke ovens of which the two oldest were built in 1907-08 and the newest was built in 1928-29. There are 210 ovens in all. The newer ovens handle 20 tons of coal per charge, which is coked in 32 hr. The normal throughput of all ovens was 1,800 tons of coal per day which yielded 1,500 tons of coke per day.

Water gas is made from coke in 11 Koppers generators and is passed in part through a catalytic converter unit to increase the ratio of hydrogen to carbon monoxide. Coke-oven gas is "cracked" with steam non-catalytically in a battery of six Cowper stoves and is mixed with converted water gas in the proportion required to give a 2½:1 ratio of hydrogen to CO. The mixed

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gas subjected to coarse purification for H_2S removal by passage through iron oxide, and then is contacted with iron oxide plus sodium carbonate at elevated temperature for fine purification to remove organic sulphur. The purified gas goes to the first stage of synthesis ovens, comprising two-thirds of the total, and then to water scrubbers and charcoal absorbers for removal of condensable products (C_2 and heavier). The unabsorbed gases pass through the second stage of synthesis ovens and to a final water scrubbing and charcoal absorption. Oil condensate from the water scrubbers is fractionated to make several distillate cuts and waxy bottoms known as "gatsch." The light hydrocarbons recovered from the charcoal are stabilized to yield benzol bottoms and a C_3-C_4 fraction overhead which is liquefied under pressure and designated by the somewhat confusing term "gasol."

The Fischer-Tropsch converters consisted of atmospheric pressure type or a medium-pressure type used at about 10 atm. The latter seemed to be preferable. All commercial operations were carried out with the cobalt, thorium, magnesia, and kieselguhr catalyst. The preparation and running in of the catalysts is extremely important. The Ruhrchemie group did not seem to be particularly impressed with the iron catalyst since losses with cobalt catalysts had been reduced to a low level, long life had been secured, and furthermore the effect of the catalyst costs on the ultimate production costs was relatively slight.

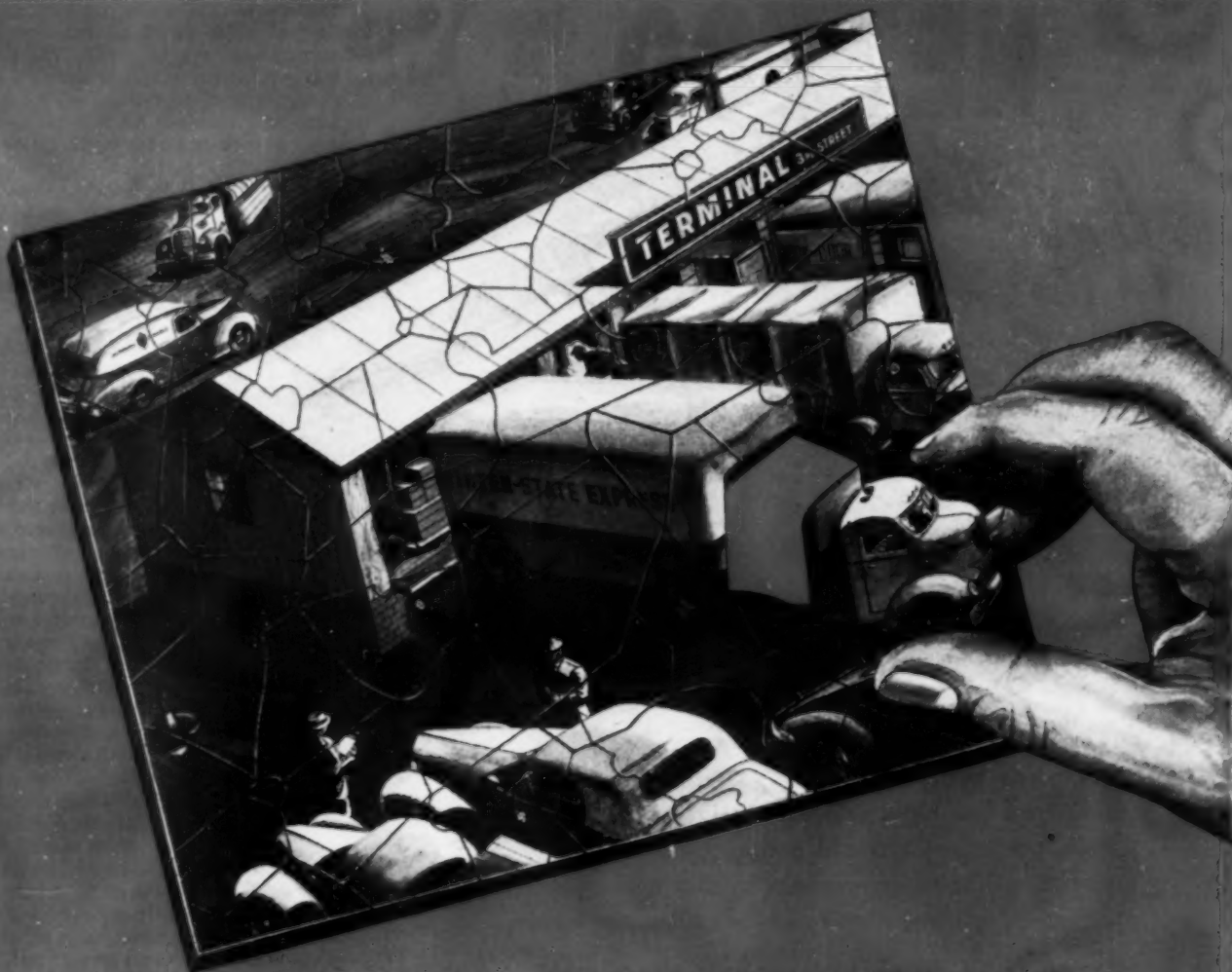
It is customary to operate 60 ovens in the first stage and 30 in the second stage, with the remaining 6 emptying and filling or out of service for repairs or catalyst washing. Synthesis gas is supplied to the first stage of ovens direct from the fine purification step at a temperature of 150-160 deg. C. and at a rate of 1,000-1,200 cu.m. per hr. per oven. The effluent is subjected to water scrubbing and charcoal absorption after passing through each stage.

One plant used a three-stage process. Recycling the gas through the converters had been tried only in pilot plant operations. There were two schemes for doing this. In the first, the gas was recycled through the converters about three volumes to each one withdrawn, using a cobalt catalyst with internal heat exchange. In the second, an iron catalyst was used with a recycle rate of about 100 to 1 and the gas was cooled externally to carry the heat of reaction away. Both the recycle operation and the use of the iron catalyst increased the octane rating of the product as a result of increased olefin content. The recycle operation also afforded a practical means of controlling the boiling range of the product.

The following shows results of two tests, one for the first stage and one for the second, chosen so that the outlet of the first stage and the inlet of the second nearly correspond.

	First Stage		Second Stage	
	Inlet	Outlet	Inlet	Outlet
CO_2	8.9	21.4	21.0	34.4
C_2H_6	0.0	1.6	0.3	1.1
O_2	0.0	0.1	0.0	0.0
CO	26.2	14.4	15.7	3.3
H_2	51.5	26.0	28.7	7.0
CH_4	0.7	10.0	7.6	14.9
N_2	12.43	26.36	26.59	39.19
Gas contraction	52.8%		32.1%	

The yield and quality of the products were about as anticipated from published information. Light gasoline of a low octane



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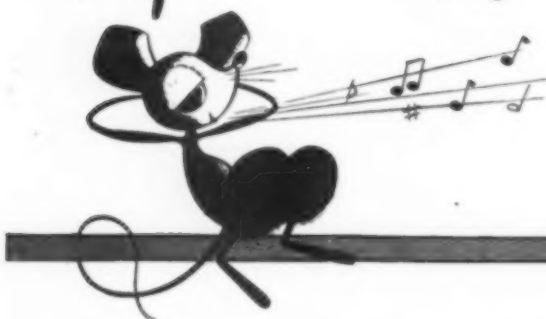
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number was secured which was blended for motor fuel. The diesel oil fractions had cetene numbers from 80 to 100. The paraffin wax was particularly desired for use in soap manufacture. It was also used for the synthesis of lubricating oil. Olefins in the overhead fractions were frequently converted to alcohols.

Several methods have been developed in Germany for the production of alcohols in connection with the Fischer-Tropsch process. The plant at Moers absorbed olefins in sulphuric acid and after separation hydrolyzed the product for the direct production of alcohol. This was used particularly for the preparation of propyl and butyl alcohols. A more interesting method, called the OXO process, was under development by Ruhrchemie; in fact, a plant had been built at Sterkrade-Holten which was about ready to go into operation. This was intended for the production of higher alcohols for use in detergent manufacture, particularly these in the group from C_{12} to C_{18} . The general type of reaction depends upon the addition of CO and hydrogen to an olefin to form an aldehyde which was then hydrogenated for conversion to alcohol. The process is carried out with a cut of Fischer-Tropsch primary product in the C_{12} to C_{17} range containing about 40 percent olefins. This is reacted with carefully purified gas containing about 10 percent more hydrogen than CO over a Fischer-Tropsch cobalt-thorium catalyst. The aldehyde is distilled off and hydrogenated over a nickel catalyst for conversion to alcohol. It is stated that this process can be used for the production of alcohol from C_2 to C_{18} , although it is largely applied in the range from C_{12} to C_{18} .

The problem of producing suitable types of lubricants for all purposes was of serious concern to the Germans throughout the war. Lubricating oil from petroleum was not sufficient to meet the demand and did not have the characteristics required for all applications. This situation forced the Germans into an extensive study of lubricating oils and means for producing them. This work met with a high degree of success and at the end of the war they were able to supply all of the necessary types of lubricants although not always in sufficient quantity. Four methods were in commercial use. One of the simplest which was well known before the war involved the cracking of Fischer-Tropsch wax or oil and subsequent polymerization to yield lubricating oil. The product was quite satisfactory for use as a general-purpose lubricant and for automobile motors. It was also reported that at the Nordeutsche Mineral Oel Werke at Politz that aviation lubricating oil with 110-120 viscosity index was made by special modifications of this process.

Another process which started with Fischer-Tropsch middle oil involved chlorination of this material and subsequent reaction of the chlorinated product with naphthalene in the presence of an aluminum chloride catalyst to yield in lubricating oil. This was neutralized, purified, and separated into greases, spindle oil, turbine oil, and motor lubricants. It did not yield exceptional high-grade material.

Based in part on an address by W. C. Schroeder, chief, Office of Synthetic Liquid Fuels, Bureau of Mines, before the American Petroleum Institute, Chicago, November 14, 1945.

CORROSION FORUM

EDMOND C. FETTER, Assistant Editor

MODERN MATERIALS • MODERN METALS

CORROSION REPORTER

THE accompanying flowsheet, for which materials of construction are designated below, is supplied by a large U. S. producer of electrolytic chlorine and represents fairly typical American practice. Following this introductory discussion, which is offered primarily as a basis for comparison, are a series of observations on German practice in the use of corrosion resistant materials in the same industry. These have been sifted from a considerable number of reports filed by the various U. S. field investigators who went through Germany in 1945. As an overall conclusion, it would appear that American and German producers rely on the same materials and that there is no general tendency in Germany to depart from customary practice, though there are a few particular cases where interesting innovations have been made.

In the American plant which is taken as more or less standard for this country, brine is fed to the electrolytic cells through hard rubber lines. Wet chlorine from the cells is handled in stoneware apparatus, including lines, cooler, brine trap, and sulphuric acid drying tower. Dry chlorine is handled in steel (XH pipe, trap, condenser, and storage tank) and cast iron (pump and compressor).

GERMAN CHLORINE INDUSTRY—BRINE

In Germany it is not unusual to find huge waterproofed concrete pits serving as a combination storage and dissolving tank for raw salt, though in some cases salt was dissolved in rubber- or brick-lined steel tanks. At one plant raw brine was stored in four large outdoor tanks made of steel lined with sheets of Oppanol (poly-isobutylene) protected on the inside by a course of acidproof brick. Tanks where brine was treated for precipitation of soluble magnesium and calcium sulphates were usually rubber- or brick-lined steel. One plant filtered the resultant slurry through polyvinylite cloth on wooden frames, while another filtered brine on its way to cell feed tanks through a paper medium. The paper had been in use since cotton became critical and has proved to be more satisfactory than cotton both in life and lower turbidity of the brine.

In at least one German plant, recycle brine from mercury cells was put through a complicated system for the removal of chlorine. After acidification with HCl, the brine was pumped to an apparatus resembling a barometric condenser where it was sprayed into a vacuum of 400 mm. Hg. To remove more chlorine it was transferred to an empty tank and blown with air. All equipment up to this point, including pumps, lines, and valves, was either stoneware or rubber-lined. The final step in the process removed the

last traces of chlorine by treatment with caustic and sodium sulphite.

CELLS AND CELL GAS

The cells themselves were predominantly of the shallow-trough mercury type and were rubber lined, except for the purposely exposed cathode area on the trough bottom. One plant which had no rubber coating facilities near its cell room lined some of its cells with Oppanol and acidproof tile set in ordinary portland cement. Another employed a glass and brick lining. Billiter (diaphragm) cells were bare steel in the bottom (cathode) section and brick-lined above the cathode. Covers for both type cells were slabs of sandstone, concrete, or rubber-covered steel, luted with chlorinated oils, cement, pitch, or putty.

Warm, moist chlorine from the cells was usually led through stoneware pipe to rubber-lined mains; one operator estimated that natural rubber in these mains had a life of five years. If a trap was used to remove entrained brine, glass wool was usually the filter medium. Coolers were of two types: surface, and direct contact with water. Contact coolers were stoneware or rubber- and brick-lined steel. Surface coolers consisted ordinarily of rubber-lined steel boxes with stoneware coils; water flowed through the coils while chlorine passed over them and on through three or four boxes in series. In some plants the procedure was reversed and chlorine passed inside stoneware coils immersed in water in an unlined steel tank.

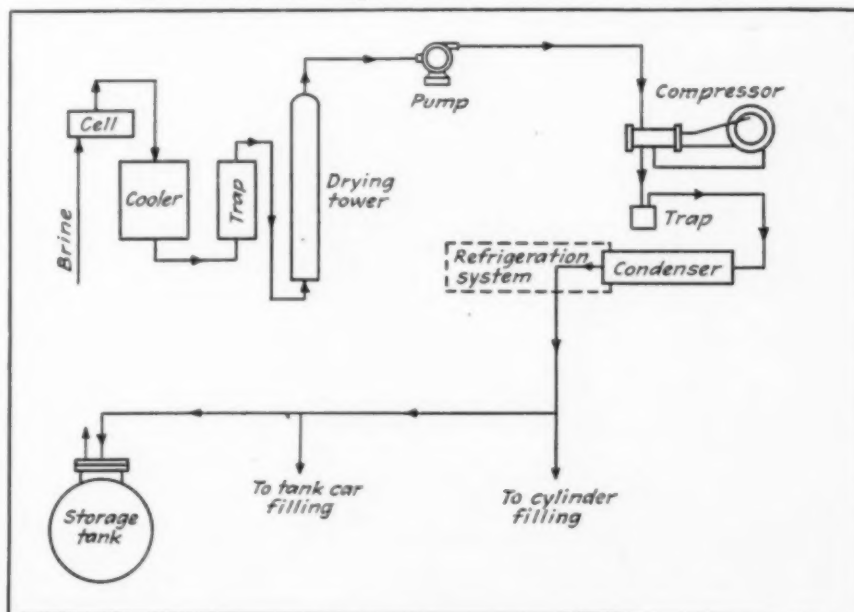
Sulphuric acid was used to dry the gas and the drying towers were variously stoneware, plastic- or rubber-lined (with an inner protective course of brick), or in one case cast iron. Choice depended on individual preference or local conditions. High-silicon cast iron was the accepted pump material for circulation of sulphuric acid around the towers.

CAUSTIC, HYDROCHLORIC, AND MERCURY

Mercury cell liquor must be filtered to remove carbon particles, for which purpose porous carbon and sintered nickel-powder filter tubes have been used in a back-washable machine. In one plant caustic was concentrated from 50 percent to 70 percent in nickel, forced circulation evaporators and was brought to the anhydrous condition in cast iron pots of eleven-ton capacity. These pots were unique in that they had strong tight-fitting tops and were operated at a finishing temperature near 440 deg. C. at a vacuum of 360 mm. Hg. Since adopting vacuum operation, pot life had been increased from 100 to 250 charges per pot. Some of the newer pots had been installed in a fully suspended, dutch-oven type of setting which has also made for much longer pot life.

Many of the German plants burned hydrogen with chlorine to produce hydrochloric acid. A typical system consisted of silica burners located in the bottom of cylindrical brick-lined furnaces about 3 ft. in diameter and 12 ft. high. Brick-lined pipes carried

Simplified flowsheet of typical American electrolytic chlorine plant



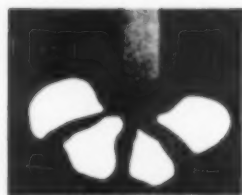
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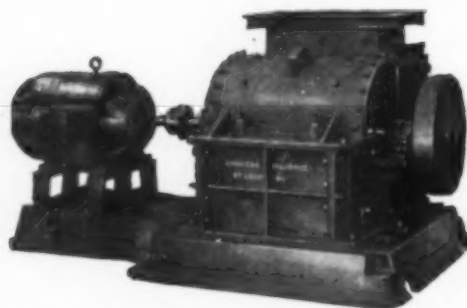


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the reaction vapors to a stoneware and rubber-lined absorption system. The one unusual feature of this system was the liberal use of polyvinyl chloride plastics as pipes, small tanks, hoods over motors, and entire valves. Large piping containing ells and other fittings appeared to have been "welded" with multiple deposited beads. All-silica furnaces have also been used with considerable saving of space over the brick-lined type.

A really unique system was found in one plant. With the exception of short silica burner pipes, the entire apparatus was lead and consisted of a horizontal furnace 14 in. in diameter and 30 in. long, terminating in a 2-in. dia. pipe coiled downward and long enough to give approximately 52 sq.ft. of surface. The entire assembly was immersed in an open tank of water which was air-agitated and circulated to keep water temperature at about 70 deg. C. Each furnace was connected to a glass and rubber wetted-wall type absorption system. Over-all capacity of eight such furnaces was about 600 tons of anhydrous HCl per month.

Trouble was experienced in all German plants with mercury poisoning caused by vanadium contamination from their graphite. German graphite had to be made from coal tar and it contained enough vanadium to get into the mercury in large enough amounts to so lower hydrogen overvoltage that 3-4 percent hydrogen appeared in the cell gas; that concentration was considered dangerous from the explosion standpoint.

To keep out Cl₂, rectifier rooms were sometimes kept under slightly positive pressure with freshly filtered air.

NEWS BRIEFS

FIVE educational lectures on corrosion (listed in November 1945 issue, p. 234) will be delivered as part of ASM's technical program for the National Metal Congress, Cleveland, Feb. 4-8.

FINAL details on the corrosion session to be sponsored by the Corrosion Division of The Electrochemical Society have not yet been announced, except that it will be held as part of the Society's national convention, Birmingham, Ala., April 10-13. It is expected that the final program will be available for publication in February.

NATIONAL Assoc. of Corrosion Engineers will hold its 1946 annual convention in Kansas City, Mo., May 7-9.

BATTELLE Memorial Institute recently announced that the Navy Office of Research and Inventions has sponsored an extensive program of research into the fundamental science of heat-resistant alloys and ceramics. During the war, high-temperature alloys and metal-ceramic combinations were successfully developed for gas turbines and jet-propelled planes, but they were developed by empirical methods—systematic variation of composition—and not by working out the basic theory of such systems. Now, in order to promote further advances, the Navy wants to establish a scientific footing for high-temperature materials. Although Navy thinking is primarily in terms of gas turbines, jets, and rockets, any information forthcoming will be available for application to materials of chemical plant construction.

FROM THE LOG OF EXPERIENCE

DAN GUTLEBEN, Engineer

THE IMPULSE that suggested the establishment of the beet sugar industry in Michigan was the circumstance that the vigorous "Captains" had logged off the timber from the Michigan lands. Some of the trees had been fashioned into ships to carry the products to the customers. New business had now to be found to fill the ships and bring productivity to the barren fields. The Captains switched from trees to beets. The legislature, influenced by important members who owned large tracts of logged-off lands, promulgated a law in 1897 under which a bounty of 1c. per lb. was promised to producers of beet sugar extracted from Michigan soil and refined in Michigan factories. The life of the act was fixed at the happy figure of seven years.

Such additional influence as editorial printer's ink, junkets to the new factories in Nebraska, Utah and California, and the propaganda of famous Dr. Kedzie, chemical wizard of State College, focused at the informal discussions in the Bay City Business Men's Association and crystallized into the mechanics under which the pioneer Michigan Sugar Co. was organized in 1897. The head of the outfit was Captain Thomas Cranage whose principal business, besides shipping, was the refining of salt. A site was selected on the shore of the Saginaw River in the Bay City suburb of Essexville. When one recalcitrant property holder refused to go along in releasing his parcel for the factory site, the kids collected the wood for the pyre that burned his effigy and thus encouraged compliance.

A CONTRACT for the construction of the factory was given to Frederick W. Wolf, famous builder of Linde Ice Machines for breweries. He acquired versatility in sugar house construction in Germany. When the lack of some small tubing on a Russian job threatened delay, he found in a nearby junk shop a quantity of rifles having the bore he needed. By welding the gun barrels together he got his pipe.

THE MICHIGAN FACTORY was expected to be ready for operation on Oct. 1, 1898, but beet slicing did not start till a month later. On the first day, the plant cut 34 tons of beets and it required several weeks to make the adjustments of the new men and machines to reach the guaranteed rating of 350 tons per day. One thousand farmers, cultivating 3,000 acres of logged-off timber land in 21 counties of the state, delivered 32,047 tons of beets and from these the factory processed 5,271,000 lb. of sugar. The manufacturing cost per pound of sugar including labor, beets and all materials came to 3.65c., as against Wolf's guarantee of 3.5c. To satisfy the situation, costly additions were exacted from Wolf.

The state bounty of \$28,000 earned up to January "1" was paid but the remaining \$24,000 due for January and February was refused. The state treasurer insisted on a ruling of the state supreme court on the constitutionality of the act. This, as is usually the case required much time and in fact the answer was not returned until late in the autumn of 1899. In the meantime eight more beet sugar factories had gotten under construction in the state. Then the Supreme Court declared the bounty act unconstitutional. The state treasurer even made an effort to compel the company to return the \$28,000 already paid but in this he was unsuccessful.

Thus, for the price of \$28,000 and an unconstitutional legislative act, the state induced the establishment of nine beet sugar factories costing about \$4,000,000 and producing a generous increase in taxes through improved farm values and greatly increased commercial activity in at least nine communities. The momentum even carried the activity through a dozen more factories in the following three years. It was a successful hoax. Governor Hazen S. (Potato) Pingree, who ameliorated the effect of a depression a few years earlier by planting potatoes in the empty lots of Detroit, signed the original law and later expressed regret.

THE MINUTES of the company reveal that they bought about one million brick at \$4.75 delivered to the site. There is a record of an expenditure of \$12 for horse hire from the Bay City Omnibus Co. This horse drew a tram car on top of a high trestle to deliver pulp to the silo. Occasionally the horse toppled off into the pulp but suffered no serious inconvenience. However his awkwardness interrupted sugar production. A barrel of sugar was shipped to the Paris Exposition in 1900 and won the gold medal which now decorates the wall of president Childs' office and verifies the company's trade mark "Pioneer." In 1901 the stockholders issued a unanimous vote of appreciation for the President's efficient and faithful service and authorized him to take a vacation and increased his annual stipend from \$4,000 to \$5,000.

There is a humorous implication in a statement by President Cranage that he collected a rebate of \$1,405.92 from the Monitor Coal Co. representing an overcharge on the year's coal. Promptness is required in the payments for beets to maintain the important asset of farmer goodwill. However in the case of coal, usually purchased in a buyer's market, the seller practices patience to hold the buyer's goodwill. Next to beets, the largest item of supplies entering into the manufacture of sugar is coal. The payment of the large coal bill is postponed by the buyer with the least dis-

comfort to himself. At least five beet sugar plants which have succumbed to financial reorganization have been taken over by coal suppliers! The coal bill seems to have an affinity for distressed sugar houses.

OPERATION of the factory prospered notwithstanding that competition for beets was set up by the establishment of a 600-ton factory in 1899 just on the other side of the fence, and another a few miles to the north. In 1900 a fourth factory was erected in the Bay City area in the suburb of Salzburg. In 1903 the two neighboring factories in Essexville amalgamated. The company now had a 400- and a 600-ton factory, the two being separated by the width of a roadway. Their animal at least had only one head though it still carried two tails. In 1905 the Pioneer plant was closed and two years later it was moved to Waverly, Iowa.

SAGINAW RIVER ROAD is joined at right angles by a highway from the beet fields below Bay City. Here three men went to sit guard on the fence to watch the farmers bring in beets. Each sitter represented one of the competing factories, two being located on the right branch and one on the left. Each sitter urged delivery to his own plant irrespective of farmer contracts with the companies, and each was supplied with cigars and hip flasks to supplement his persuasive efforts.

The rugged individualistic factor to the left who notoriously declined to "go along" with the others was alleged to have stationed a pay master at the tare scale to pay the farmers cash on the spot as an extra inducement. He "could not make sugar out of contracts." His plant operated until 1936 when it was closed. The influx of thousands of war workers to the neighboring war plants demanded garden truck. The farmers grew apathetic to beet culture and besides the old plant suffered from obsolescence and ill maintenance and finally succumbed like the one-hoss shay. The individualistic owner vindicated his stewardship by paying dividends annually even after his plant was idle. Furthermore in his personal affairs he has generously practiced philanthropy. In one of his letters to the chronicler he apologized for its appearance. His secretary, having looked after his personal affairs for 40 years, had "up and quit."

IF ALL OF US HUMANS could live peacefully and harmoniously, we might install the practice of free trade. Then every section of the surface of the earth would produce only according to its God-given advantages. However it has been most useful to have a temperate-zone source of sugar right here at home especially during the War. There are, furthermore, agricul-

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tural advantages to justify the import duty. Raising beets demands highly scientific farming. Secretary Wilson announced that rotating grain with beets so improves the farm and the farmer that 25 percent of the land taken out and planted to beets does not reduce the total grain crop. The pulp and tops from one acre of beets possess the same feed value as an acre's crop of hay or grain. As a means of obtaining cash for the imperial treasury (about \$100,000,000) the tariff has a sort of equable quality. The fellow who suffers from diabetes is relieved of the tax. The excessively corpulent individual who smothers the strawberries and cream with sugar pays a little more tax and it serves her right! Congress fixes the tariff to protect only the most economical domestic producers and this affects producers of beet, cane and corn sugar at home and in the insular possessions.

HENRY OXNARD'S Nebraska operation was followed in 1891 with a new sugar house in Chino, Calif. That delightful Frenchman, Louis Hasche, was sent out to organize the agricultural division and he was accompanied by a variety of the European experts imported by Oxnard the year before. The Chino factory and operating crew were of German propagation. To maintain morale and provide relaxation, Hasche arranged periodic dinners at which each guest's chair was surmounted with a flag to represent the nationality of his origin. The festivities were inaugurated with each man getting up in turn and drinking a toast to his home land. When it came the turn of Joe Sailer (later superintendent) to occupy the toast-master's chair, he instituted the convention which required the head of the table to rise with each guest and return the toast under the salutation of "prosit." A good man could take it but it was a severe test. However the wily chemist Hans ("Mendy") Mendelson, was alleged to have found the secret. According to one of the many traditions that grew up about this famous chemist, when the liquor level reached his Adam's apple he "took a walk," stuck his finger into his throat and presto was prepared for further duty!

MENDY'S FAVORITE SPORT after he moved to Colorado about 1905 was to tramp in the woods. He would engage a horse and buggy and fill the "hold" with liquors in great variety. His lone comrade on these trips was young Ollie Cummers (now superintendent of Windsor) who served as companion and bell-hop without stipend. For road information Mendy would flag four-team freighters who roamed the uncharted wilderness. His approach was always an invitation to "join" by way of the formula "what will you have?" Whatever the choice, Mendy had it.

MENDY ATTRACTED POPULARITY not only because of his humor but also for his unusual musical talents. In fact wherever Mendy was there was the center of joy and conviviality. The old boarding house phonograph that used to scratch out popular songs ad infinitum annoyed him no end. When he could endure it no longer he picked up a pound of butter and cast it into the horn.

Mendelson was born in a parsonage in

the middle of the beet sugar industry in Germany. He was earmarked to follow the footsteps of his father, but his desires did not incline in that direction. However, he pursued the cultural curriculum of the times including especially literature and music. There is a suspicion that his mastership at the piano came by descent from the great virtuosos! In the end, he received his technical degrees from Tübingen and the Sugar Institute of Brownschweig. Henry Oxnard discovered him in 1899 in the research laboratory of the great seed farm in Kleinwanzleben and dispatched him to the Oxnard California factory to lay out the system of chemical control. To fill an important need, he compiled a handbook for sugar house chemists. After 1901 he joined in the design and preliminary operation of 14 factories with the construction firm of Kilby Mfg. Co. and then settled down as a research expert in the exploitation of Nature's chemistry in the beet fields of the Great Western Sugar Co. At the time of his death in 1933, he was engaged in writing a book of his experiences. This work unfortunately remained unfinished and a part of his collection of scientific material was lost in a railway accident. Mendelson's outstanding quality was his seriousness of purpose on the job, but when the craftsmen craved relaxation, he was the indispensable dispenser of good humor. There could be no gloom when Mendy was in the house!

COLLECTING TRADITIONS of the old industry grows into a fascinating activity. At Wallaceburg, Ont., the chronicler picked up the greetings of Bob Lauber, superintendent emeritus of the local sugar factory, and delivered them to his sister, Mrs. Stolley, at the farm near Grand Island, Neb. Bob had started as waterboy on the construction of the Grand Island factory in 1889. Mrs. Stolley's husband presently came in from his work. She urged participation at lunch but explained that in these times of rationing it is impossible to be prepared for unexpected guests. Her husband had caught two carp and these were even then sizzling on the fire. For the guest she prepared a bowl of soup of German design containing the nourishing ingredients of ham, peas, onions, and potatoes. Carp possesses a flavor that requires to be developed but soup is universal. Mrs. Stolley contributed old pictures of the operators of the sugar house, the gifts of the principles themselves 55 years ago. The women are of course the conservers of family history.

A GENEROUS CONTRIBUTOR to the promotion of the beet sugar industry in Bay City, Mich., was Frank Zagelmeyer. He published "The Sugar Beet Culturist" that aroused interest in the establishment of the pioneer factories. In 1901 he went to California for a two-year apprenticeship in beet raising on a dirt farm in order that his "gospel" may become the more authoritative. Then he returned to Bay City, raised beets and published agronomic information but made his living out of the manufacture of paving brick and cement building blocks wherein he attained affluence of a respectable sort. Zagelmeyer brothers owned the Monitor coal mines which later rescued the Columbia Sugar Co. from the slough of the great depression.

NAMES IN THE NEWS



W. A. Noyes, Jr.

W. Albert Noyes, Jr., chairman of the chemistry department of the University of Rochester, has been chosen president-elect of the American Chemical Society. Dr. Noyes took office as president-elect on January 1 when **Bradley Dewey**, president of the Dewey & Almy Chemical Co., and former rubber director, became president, succeeding **Carl S. Marvel**.

Harvey A. Neville, head of the department of chemistry and chemical engineering of Lehigh University, has been named director of the recently established Lehigh Institute of Research.

Beverly L. Clarke, formerly director of the analytical department of the Bell Telephone Laboratories, has been appointed director of chemical control at Merck & Co., Rahway, N. J.

Lewis F. Bacon and **Henry S. Morse** retired on January 1 as plant superintendent and planning engineer in charge of design, respectively, at the East Side plant of Monsanto Chemical Co., St. Louis.

Don H. W. Felch has been appointed manager of the new Willow Island, W. Va., plant of the Calco Chemical Division, American Cyanamid Co.

R. T. Haslam, a director of the Standard Oil Co. (N. J.) since 1942, has been elected a vice-president.

Harold W. Stiegler has been appointed director of research for the American Association of Textile Chemists and Colorists with offices at the Lowell Textile Institute, Lowell, Mass.

Milton Gallagher has joined the staff of the Industrial Research Institute of the University of Chattanooga. Dr. Gallagher was formerly associated with the Owens-Corning Fiberglas Corp. at Newark, Ohio, and the Tennessee Eastman Corp., Kingsport, Tenn.



J. G. Vail

James G. Vail, vice-president and chemical director of the Philadelphia Quartz Co., Philadelphia, Pa., was elected president of the American Institute of Chemical Engineers at their thirty-eighth annual meeting in Chicago last month. Elected to serve as vice-president was **C. M. A. Stine**, vice president and director of E. I. du Pont de Nemours & Co., Wilmington.

Walter L. Savell has been named chief research chemist of the Remington-Rand, Inc. Laboratory of Advanced Engineering at South Norwalk, Conn. For the past three and a half years Dr. Savell has been a colonel on active duty with the Chemical Warfare Service.

F. William McMillin, for the past nine years with the Firestone Tire & Rubber Co., Akron, and previously with Talon, Inc., Meadville, Pa., has been appointed chief chemist of the International Plastic Corp., Morristown, N. J.

Harry A. Kuhn, chief of the control division, CWS, was awarded the Distinguished Service Medal last month for exceptionally meritorious service in duties of great responsibility from December 1941, to October, 1945. Presentation was made to Colonel Kuhn by Maj.-Gen. **Waitt**, chief of CWS.

Theodore F. Hatch has been appointed to the staff of Industrial Hygiene Foundation at Mellon Institute, Pittsburgh. Lt. Col. Hatch was associate professor of hygiene at the University of Pennsylvania before he was commissioned in the Army.

James H. Doolittle returned to Shell Oil Co. January 1 as vice-president of Shell Union Oil Corp. Lt. General Doolittle was formerly commander of the 8th Air Force. His headquarters are in New York where his duties, in addition to general corporate responsibilities, will include coordination of the aviation interests of the Shell companies.



C. L. Parsons

Charles L. Parsons, secretary of the American Chemical Society since 1907 and its business manager since 1931, has retired. Dr. Parsons has been succeeded in both offices by **Alden H. Emery**.

Howard G. Vesper has been elected president of California Research Corp., San Francisco, subsidiary of Standard Oil of California. A graduate in chemical engineering from California Institute of Technology, Mr. Vesper has been with Standard since 1922. **Alois Kremser**, a research executive in the firm since 1926, has left as vice-president of California Research Corp. to become advisor to the president of Standard.

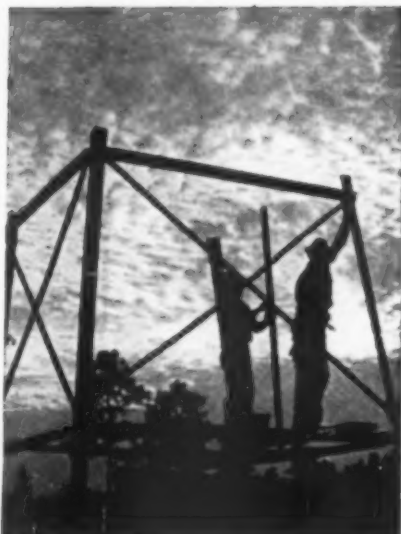
Alden H. Waitt, whose nomination was submitted November 13, was confirmed by the U. S. Senate, November 28 as chief of the Chemical Warfare Service with the rank of major-general in the Army of the United States.

R. A. Benzaquin, recently with the Butadiene Division of the Koppers Co., Kobuta, Pa., is now technical assistant to S. L. Tyler, secretary of the American Institute of chemical engineers. Mr. Benzaquin, a chemical engineering graduate of MIT, is a junior member of the AIChE.

Fred C. Shaneman has been named president of the Pennsylvania Salt Manufacturing Co. of Washington. Mr. Shaneman has been vice-president of this Washington subsidiary of the Pennsylvania Salt Manufacturing Co. since 1939.

Henry E. Perry, formerly vice-president in charge of production, has been named executive vice-president of the Commercial Solvents Corp. **Maynard C. Wheeler** of Terre Haute, Ind., succeeds to the position left by Mr. Perry.

W. S. Mounce, formerly senior metallurgist with the Hamilton Standard Propellers Division, United Aircraft Corp., East Hart-



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ford, Conn., has joined the development and research division of The International Nickel Co. He will make his headquarters at the New England Technical Section of the division in Hartford.



Anthony Anable

Anthony Anable rejoined The Dorr Co. on January 1 as director of public relations and advertising. Lt.-Comdr. Anable has been on military leave from The Dorr Co. since shortly after Pearl Harbor.

George I. Staber and M. J. Mayer have resumed their duties at Schwarz Laboratories, New York. Lt.-Comdr. Staber returned to his post of chief engineer after three years of active naval service, and Mr. Mayer resumes his duties as assistant secretary after 26 months as production engineer in the office of Inspector of Naval Material.

Edwin J. Putzell, Jr., has joined the Monsanto Chemical Co., St. Louis, as assistant to the treasurer.

Frederick B. Langreck has been transferred to the general development department of Monsanto Chemical Co., St. Louis, where he will specialize in projects for olefine manufacture and utilization. Mr. Langreck, a chemical engineer, is one of Monsanto's senior technologists. He has contributed importantly to the process chemistry of such volume chemicals as phthalic anhydride, phenol, sulphuric acid, chlorine, phosphoric acid and styrene.

William G. MacNaughton, engineer for the Newsprint Service Bureau, New York, will be the 1946 recipient of the gold medal of the Technical Association of the Pulp and Paper Industry. This award is given to an individual who has made outstanding contributions to the technical advancement of the pulp and paper industry. Presentation will take place at the annual meeting of TAPPI in New York on February 28.

Hoyt C. Hottel, director of the fuels research laboratory of the Massachusetts Institute of Technology, has been awarded the William H. Walker award for 1945 by the American Institute of Chemical Engineers. This award is given annually to a member of the institute who has made the most valuable contribution to the chemical engineering literature over three years prior

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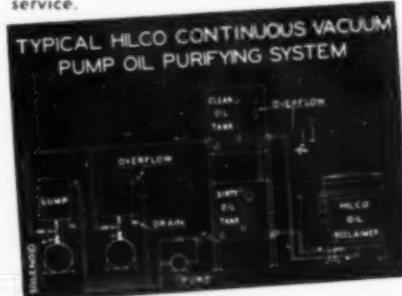
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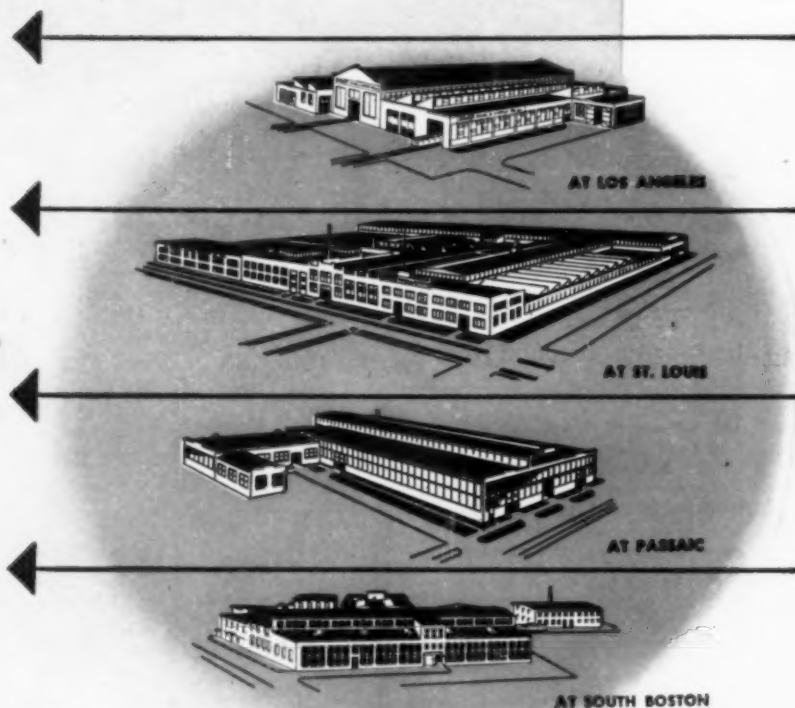
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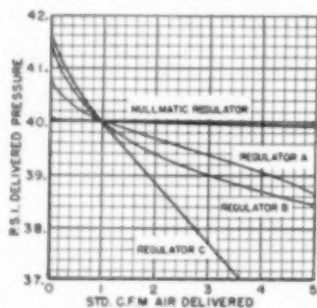
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to the award. Presentation took place December 18 in Chicago at the annual banquet of the Institute.

Bernard T. Malter, a chemical engineering graduate of the University of Illinois, has been named general production manager in charge of all production, research and laboratories for Flavor Service Corp., Chicago.

Paul Silverstone, formerly process engineer for North American Aviation, has joined the General Engineering Corp., Los Angeles, as chief engineer in charge of production.

Helge Holst has joined the staff of Arthur D. Little, Inc., Cambridge, Mass., to serve as assistant to the president. Mr. Holst, a graduate of the Massachusetts Institute of Technology and the Harvard Law School was previously with the legal department of Lever Bros.

Harry S. Olson has joined the staff of the research and development department of the Diamond Alkali Co., Painesville, Ohio, where he will assist in product development work.

John G. Dean is now with the development and research division of the International Nickel Co., New York, as senior fellow-in-absentia of Mellon Institute of Industrial Research, Pittsburgh.

M. H. Arveson has been appointed senior technologist in the recently formed chemical products department of the Standard Oil Co. (Indiana). The new department has the function of studying the market for chemical materials developed or to be developed from petroleum and of marketing these products.

Ralph E. Dorland, an executive of the Dow Chemical Co., has been elected president of the New York Board of Trade.

Milton Harris, director of research, Milton Harris Associates, Washington, D. C., was awarded the Olney Medal by the National Association of Textile Chemists and Colorists at the annual dinner of the association, January 5, in New York. The medal is awarded by the association for outstanding achievement in the field of textile chemistry.

C. J. Wilhelm, supervising engineer of the Franklin, Pa., petroleum field office of the Bureau of Mines, has been appointed to an engineering research position at the Bartlesville, Okla., Petroleum Experiment Station. Sam S. Taylor, assistant supervising engineer at Franklin, has been named supervising engineer of that office.

Ernest B. Bengert, general assistant manager of the technical division of the rayon department of E. I. du Pont de Nemours & Co., has been appointed manager of the division, succeeding M. du Pont Lee, who was recently named general consultant in the engineering division.

W. W. Hodge, former professor of chemical engineering and head of the chemical

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engineering department of West Virginia University, has been appointed a senior fellow and director of the National Council for Stream Improvement (of the Pulp Paper and Paperboard Industries) Inc., Research Fellowship at the Mellon Institute of Industrial Research, Pittsburgh.



R. P. Russell

Robert P. Russell, head of the central technical and research organization of Standard Oil Co. (N. J.), has been named to receive the 1946 gold medal of the American Institute of Chemists. Presentation will be made at the institute's annual meeting in New York in May.

Joseph S. Marx, superintendent of the Carthage, Mo., explosives plant of Hercules Powder Co., retired on January 1 after 45 years in the explosives industry. He was succeeded by John C. Foster, formerly smokeless powder superintendent at the Hercules-operated Badger Ordnance Works in Wisconsin.

Frederick Bellinger is now an associate professor in the department of chemical engineering at Georgia School of Technology, Atlanta. Dr. Bellinger has been with the Chemical Warfare Service since 1940 and left with the rank of lieutenant-colonel.

J. B. Phillips is back at his post in the department of chemical engineering at McGill University after a four-month stay in Germany as part of a Canadian scientific mission studying German scientific advances during the war.

A. F. Swain has been named manager of the insecticide and fumigation department of Pittsburg Chemical Co., Los Angeles. During the war Mr. Swain was with the Office of the Quartermaster General in the research and development branch.

William Irwin has been appointed assistant resident manager of the Ethyl Corp. manufacturing plant in Baton Rouge, La. Mr. Irwin, who comes to Ethyl after 12 years with Du Pont, supervised construction at the atomic bomb project in Oak Ridge and was associated with the construction of the atomic bomb project at Hanford, Wash.

Richard E. Deal has been elected a director and secretary of Nitrogen Products, Inc., and its subsidiaries, Benzol Distributors, Inc., and Fertilizer Forwarding Corp. Mr. Deal

"Quiz Program" on AIR TABLING . . .

TO THE ENGINEER RETURNING FROM SERVICE

Have you heard of the great progress made in Separation by AIR TABLING?

Do you know how AIR TABLING was used in War Work?

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Our engineers will be glad to help solve your separating or concentrating problems and submit recommendations. Send sample for laboratory tests.

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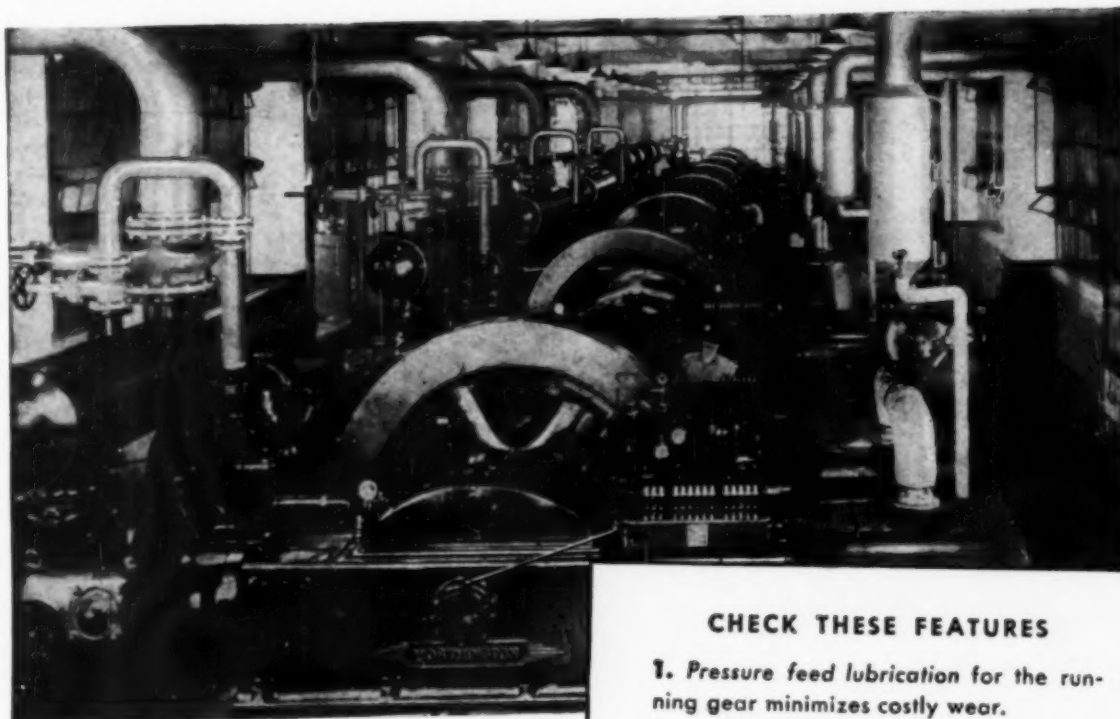
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THE PROCESS FOR BETTER PRODUCTS-FASTER

HOW TO GET LOW COST AIR FROM "NO" COST STEAM POWER



Battery of Worthington OXP Opposed Steam Driven Compressors in a large processing plant.

... with minimum outage for adjustment

In hundreds of plants where large quantities of exhaust steam are needed for heat exchangers and processing, Worthington Opposed Steam Driven Compressors with exclusive Feather* Valves are lowering air costs two ways. Because the steam drive on the compressor serves as a reducing valve on the process steam line, *power cost is negligible*... and because the composite effect of four Worthington features assures continuous heavy-duty service, *maintenance costs and outage time are kept at a minimum.*

*Reg. U. S. Pat. Off.

CHECK THESE FEATURES

1. Pressure feed lubrication for the running gear minimizes costly wear.
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These and other features that add up to low maintenance cost, high operating economy, freedom from operators' Sunday work prove that *there's more worth in Worthington.*

Write for literature... Publication Dept., Harrison, N. J. Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, N. Y.

WORTHINGTON



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—The data and methods
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every piping problem

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1376 pages, 4 1/2 x 7 1/2,
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THIS vast handbook covering the fundamentals, materials, and techniques of modern piping practice is now enlarged by 500 pages, including four new chapters in line with the increasing importance of piping systems in industrial operations. Tables and charts, abstracts, standards, and specifications, etc., have been revised and improved, and scores of new facts and figures added. Now more than ever the **PIPING HANDBOOK** is an invaluable self-contained key to effective piping practice.

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has just completed four and a half years as a lieutenant-commander in the U. S. Navy. Prior to service with the Armed Forces, Mr. Deal was employed by the Barrett Division of Allied Chemical & Dye Corp.

C. F. Johnson has joined Watson-Stillman Co., Roselle, N. J., where he is in charge of all engineering in the forged steel fitting and the bronze and forged steel valve divisions.

Robert T. Baldwin has been appointed executive secretary and assistant treasurer of the Association of Consulting Chemists and Chemical Engineers, Inc., for one year.

OBITUARIES

Fan Hsu-tung, president of Yung Li Chemical Industries, Ltd., who organized the first Solvay soda plant in China and developed the Yung Li industries in subsequent years, died suddenly in Chungking October 4.

Robert D. Landrum, 63, chemical engineer and executive of the Harshaw Chemical Co., died in Cleveland, November 30.

Alan E. Flowers, 69, for more than 20 years head of the research and development department of the De Laval Separator Co., died in Poughkeepsie December 3.

Herbert J. Kaufmann, 41, manager of the Baltimore plant of the Mutual Chemical Co. of America, died in New York December 17.

Paul F. Kerschbaum, 58, an internationally-known chemical engineer, died in Dayton December 18.

Frank S. Warzeski, vice president of The Linde Air Products Co., died in Montclair, N. J., December 21.

Charles C. Hall, 70, founder and vice president of the Durametallic Corp. of Kalamazoo, died at his home December 26.

David Andrew, 66, president of the Ferbert-Schorndorfer Co., paint manufacturers, died at his home in Shaker Heights, Cleveland, December 27.

D. Romund Moltzau, 36, a staff member of The Institute of Paper Chemistry, Appleton, Wis., since 1935, died December 27.

Edward J. Forth, 52, president of the Gibson-Homans Co., paint, varnish and lacquer makers, died in Shaker Heights, Cleveland, December 28.

Louis C. Jones, 75, internationally known chemical engineer and former director of the Stamford laboratories of the American Cyanamid Co., died in Greenwich, Conn., December 29.

William J. Waite, 51, chemical engineering graduate of the University of Kansas, chairman of the board of the Clinton Trust Co., New York, former chief chemist of the Hercules Powder Co., and a director of a number of organizations, died in Shawnee-on-Delaware, Pa., January 1.

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WILL DO YOUR PUMPING JOB BETTER

SEE... WHY

Check the principle of operation, and you'll see why Bump Pumps have a lower maintenance cost. There are only 2 moving parts, no grease cups and no internal threads. Bump Pumps are easy to clean and easy to maintain. As one company who has used a large number of Bump Industrial Pumps says, "They do a better job at a lower total cost to us than any other pump now offered the chemical industry." Available in capacities from 1/2 to 400 GPM, and in different models and metals suitable to the job. Complete catalog upon request.

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HAS A LOT OF FACTS
ABOUT POST-WAR
PACKAGING
THAT ARE
IMPORTANT

to you!

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Multi-Wall
BAGS

**FACT
NO. 1**

Hammond Multi-Wall Bags are *economical*. First cost is the *only* cost. No handling, cleaning, storage or freight charges on "returned containers." No "returned bag" nuisance.

**FACT
NO. 2**

Hammond Multi-Wall Bags are *sanitary*. They provide adequate protection against insect infestation, dirt, cinders, etc., assuring content purity and cleanliness. Also sift proof to keep the product "in" and the dirt "out."

**FACT
NO. 3**

Hammond Multi-Wall Bags are *strong*. They are built to stand rough handling and to "deliver the goods" without loss or damage.

**FACT
NO. 4**

Hammond Multi-Wall Bags are *weather-proof*. Rain, snow, sleet and leaky cars hold no terrors for shippers of these containers. Special *moisture-proof plies* for products requiring extra protection.

**FACT
NO. 5**

Hammond Multi-Wall Bags are *convenient*. They are not only easy to handle, but also easy to pile, easy to open and easy to use!

**FACT
NO. 6**

Hammond Multi-Wall Bags are *attractive*. Bright multi-color printing identifies your company, brand and product to the ultimate consumer—*your* customer.

Just ask the Hammond Man!

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Fig. 631

Are all of your processes using Spray Nozzles as efficient as you think they could be? Do the Sprays distribute the liquid evenly? Break it up into as fine particles as you would like? Resist the corrosion or wear conditions satisfactorily?

Send Monarch an outline of any spray problem—If your liquid can be sprayed with direct pressure at all—Monarch can furnish the nozzles.

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INDUSTRIAL NOTES

Mattson Chemical Co., Los Angeles, has been formed to act as west coast agent for chemical manufacturers. K. C. Mattson, formerly Los Angeles branch manager for the Griffin Chemical Co., heads the new company. Offices are at 124 West Fourth St.

Dow Chemical Co., Midland, Mich., has extended the area of the sales office at Washington, D. C. to include Virginia, North and South Carolina. This additional territory had been under the direction of the New York office.

The Hooker Electrochemical Co., Niagara Falls, has assigned Charles Y. Cain to the sales territory in the vicinity of Chicago. He has spent several years in the plant and in the Niagara Falls sales office.

General Electric Co., Pittsfield, Mass., has appointed T. J. Holmes sales manager for the New England district. He will be located temporarily at Lynn, Mass but later will establish headquarters in Boston.

Wagner Electric Corp., St. Louis, has moved Forrest G. Wilson from Dallas to manage the Indianapolis branch. H. F. Zahn formerly manager at Atlanta has been made manager of the Philadelphia office. C. G. Jackson has been transferred from Boston to head the Atlanta branch and J. K. Miller moves from New York to take over the management of the Boston office.

Fuller Co., Catsauqua Pa., has moved its branch office in Chicago to 120 South La-Salle St. C. C. Kaesemeyer is manager of the office.

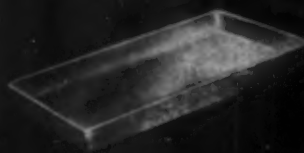
Sun Chemical Co., New York, has acquired the Warwick Chemical Corp., whose main plant is at West Warwick, R. I. Other plants are at Wood River, R. I., and Rock Hill, S. C. Subsidiaries are the Warwick Wax Co., with a plant at Chanute, Kan., and Impregne Corp. of New York, a sales organization for distribution of Warwick's fabric finishes.

Bemis Bro. Bag Co., St. Louis, has acquired a building at 5401 East Slauson Ave., Los Angeles, and will equip it for the production of bags to fill packaging needs in the Pacific Coast area. C. H. Decker who has been in charge of sales in Los Angeles has been appointed manager for the new plant.

Westvaco Chlorine Products Corp., New York, has assigned W. L. Sager to the Brooklyn and Long Island sales territory. Patrick H. Hall has been added to the staff to cover the Manhattan territory to succeed John P. Hackett now resident salesman at Providence, R. I.

Stacey Brothers Gas Construction Co., Cincinnati, has appointed William E. Mikolasy as eastern sales representative. He will be located in the office of Dresser Industries,

TWO TRAYS *They look alike*



But What a Difference in PERFORMANCE!

Amersil*

ANNEALED SILICA products have an inner strength and endurance that silica ware never had before. Amersil trays, and other products by Amersil, don't start with two

strikes against them. They have: (1) uniform wall thickness, (2) all strains and stresses removed — thus they are better able to withstand the shattering effect of repeated thermal shock. For silica ware that endures — specify Amersil. Write for interesting bulletin.

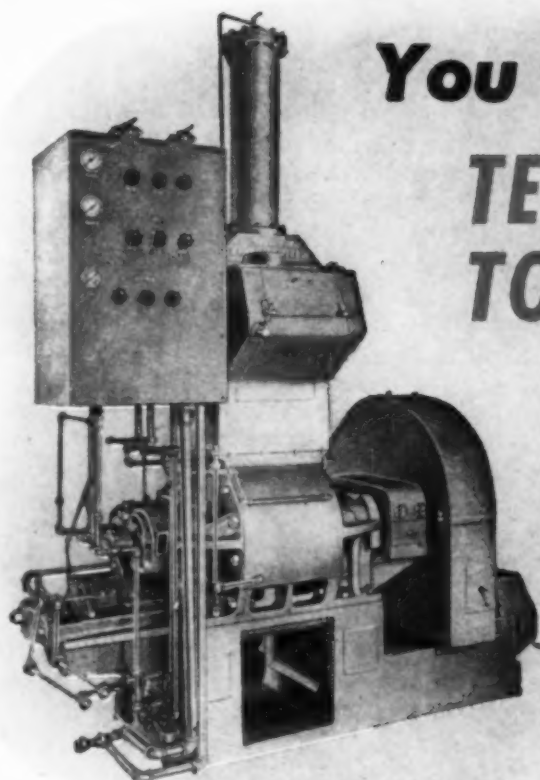
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You can "tailor" TEMPERATURE TO FIT THE PLASTIC with a **BANBURY**

With a Banbury Mixer you can accurately control the batch temperature for whatever plastics stock you are processing.

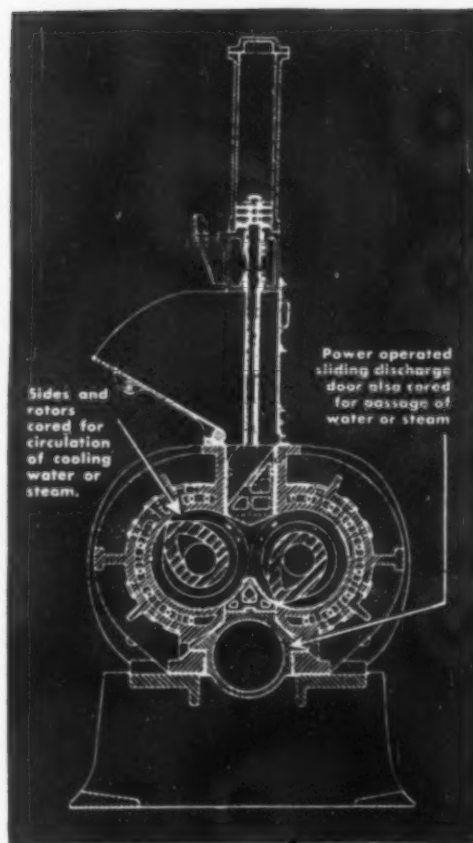
There are several features of Banbury design which make this possible. Essentially, the machine consists of a completely enclosed mixing chamber in which two rotors operate, a hopper to receive the materials for mixing, and a sliding door for discharging the batch. The chamber walls, rotors and sliding door are cored for circulation of steam, cooling water or other temperature controlling medium. This means that practically the entire surface in contact with the batch is put to use in keeping the temperature under close control.

An electrically actuated potentiometer pyrometer, with its sensitive element, a thermocouple, in direct contact with the batch, indicates and records the temperature on a chart. Valves and gauges for the various temperature regulating circuits are mounted on a panel at the operating platform. By manipulating them it is a simple matter to bring the batch temperature to the desired point and keep it there.

Another important control device supplied with all production size Banburys is the telechron-motor-operated timing instrument which automatically signals the operator as each stage of the operating cycle is completed.

Optional equipment includes an automatic discharge control, operated either by the timing device or the temperature control. This mechanism automatically opens the door and keeps it open long enough for complete discharge of the batch.

Banbury Mixers are built in nine sizes for laboratory and factory use. For complete information write for Bulletin No. 180.



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Plants: Ansonia, Derby and Stonington, Conn.,

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Sales Offices: Ansonia, Buffalo, New York, Pittsburgh, Akron, Los Angeles, Tulsa, Houston, Charlotte

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Continental Transmission Drives

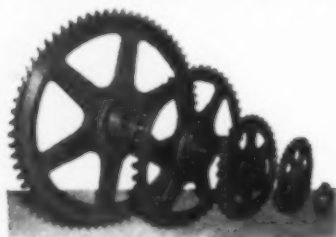
We are equipped to engineer and specify the correct drive for each individual installation—whether a positive drive such as Chain or Gears or a flexible drive such as V-Belt or Flat Belt.

V-Belt Drives



A complete line of V-Belt Sheaves for "A" through "E" section belts in standard bushed, taper bushed or made-to-order types. Continental V-Belts "A" through "E" section carried in stock for prompt shipment. All Sheaves made from close grain, high tensile strength Meehanite iron, assuring longer life expectancy and highest drive efficiency.

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Complete range of stock size Sprockets and single strand Roller Chains, from 3/8" to 2 1/2" pitch, carried in stock for quick delivery. Steel or cast iron construction, with standard, detachable or breaking pin hubs, are available on order

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67-A

INDUSTRIAL DIVISION

CONTINENTAL GIN COMPANY

BIRMINGHAM, ALABAMA



ATLANTA • DALLAS • MEMPHIS



122 East 42d St., New York. Walter E. Flagg will handle sales in New England with an office in the Park Square Bldg., Boston.

Godfrey L. Cabot, Inc., Boston, has announced that Raw Materials Co., 220 East 42d St., New York, is now its exclusive sales agent for all types of carbon black and pine distillates. Commander Edward F. Heckman, recently released from the United States Navy will manage the New York office.

Rheem Research Products, Inc., Baltimore, has appointed Charles C. Martin vice president and he will assume many of the duties previously held by the executive vice president for management. Mr. Martin had been serving as administrative manager and assistant director of the company's research laboratories in Pasadena, Calif.

Attapulgis Clay Co., Philadelphia, announces the retirement of William A. Edsall, for many years vice president in charge of sales. He is succeeded by Robert H. Hubbell, Jr. William S. W. McCarter has been named technical director to succeed Mr. Hubbell.

Link-Belt Co., Chicago, has moved Joseph W. Sears from Dallas to Houston where he will have charge of district sales. Stuart Penick succeeds him as district sales engineer at Dallas.

Shell Oil Co., Inc., New York, announces that Lieutenant Commander Selwyn Eddy, who had been on military leave since July 1942, will become manager of the marketing division. Ralph Carey, who had been serving as acting manager has been named assistant manager.

Koppers Co., Inc., Pittsburgh, has been negotiating for the acquisition of all the capital stock of Wailes-Dove-Herrington Corp. whose main plant and offices are in Westfield, N. J. In exchange it was reported that Koppers would issue 15,550 shares of its common stock and pay \$100,000 in cash.

The H. K. Ferguson Co., New York, has consolidated its offices for sales formerly at 25 W. 45d St. and those for engineering formerly at 420 Lexington Ave. The two offices now occupy greatly increased space at 119 W. 57th St. G. E. MacMillan will direct sales and preliminary engineering. T. K. Rothermud will head the expanded engineering department.

Manning, Maxwell & Moore, Bridgeport, Conn., has placed Charles L. Harris in charge of distributors sales. Newton P. Selover has succeeded Mr. Harris as manager of the mid-western-district. William F. Loos has been appointed eastern district manager with headquarters in the Chrysler Bldg., New York. William H. Bolin succeeds Mr. Loos as mid-eastern manager with headquarters at Pittsburgh.

A. R. Maas Chemical Co., South Gate, Calif. has added Nelson A. Howard, Jr., to its staff. He will engage in sales and market development work. During the war Mr. Howard was Lt. Commander in the Naval Reserve, Aviation Branch, and prior to that

AGALLOY



TUBING

Sizes up to $\frac{3}{8}$ " O.D.

High carbon	} Seamless Welded Spiral Brazed
Low carbon	
Alloys	
Bimetal	



Corrosion resistant

TUBING

Sizes $\frac{3}{8}$ " O.D. and smaller

Monel metal	} Welded or Seamless
Inconel	
18-8 Stainless	
Nickel	



TUBULAR FORMS

Sizes to 4" O.D.

Stainless steel	} Coiled from Strip
Monel metal	
Carbon steel	
Brass	
Copper, etc.	

Write for complete catalog. No obligation involved.

AGALLOY TUBING COMPANY

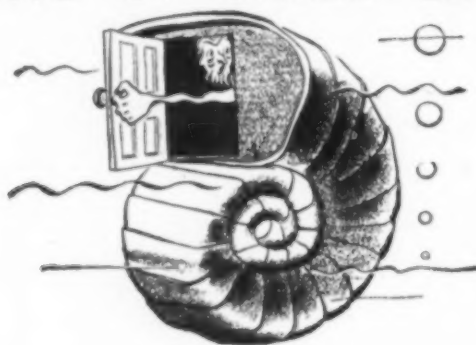
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AGALLOY
Headquarters for all
small tubing
in seamless, welded
and spiral brazed

SPEAKING OF SHELL CLOSURES



WHITLOCK

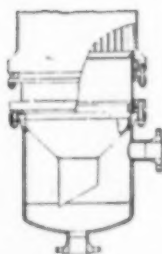
Engineered EXCHANGER DESIGN

The optimum performance of Whitlock Heat Transfer Equipment is the result of carefully considered design to meet specific operating conditions. Typical of Whitlock engineering is the selection of the most suitable design of rear shell closure based on such major considerations as:

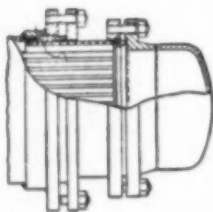
1. Fluids entering
2. Influence of design on heat transfer rates
3. Pressures and temperatures involved
4. Cost of construction

Whitlock engineers have had over fifty years' experience in the design and fabrication of heat transfer equipment of all types, and will gladly make recommendations.

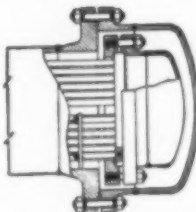
WHITLOCK REAR SHELL CLOSURES



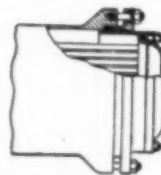
Separator type for vapor tube condensers



Outside packed, piston ring type



Split ring type



Outside packed flush reversing type channel

THE WHITLOCK MANUFACTURING CO.

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Boston

Chicago

Philadelphia

Detroit

Richmond

Authorized representatives in other principal cities.

In Canada: Darling Brothers, Ltd., Montreal

Established 1891 — Ahead of the times for half a century

was with American Cyanamid & Chemical Corp. at Houston, Texas.

Pennsylvania Salt Mfg. Co., Philadelphia, has appointed Ross E. McBride to the sales and service staff of its laundry and dry cleaning division. He will cover the newly created Pittsburgh and West Virginia territory. Joseph M. Edmondson has been added to the staff in the Virginia territory.

United States Rubber Co., New York, has named John S. Lawrence as district sales manager of the Denver branch, mechanical goods division. During the war he served as the company's specialist to the aircraft industry at Wichita, Kansas.

Tennessee Eastman Corp., Kingsport, Tenn., has opened sales offices in New York at 10 E. 40th St. A. M. Tenney Associates, Inc., located at the same address will continue to act as sales representatives for the company's acetate rayon and staple fiber. Sales of plastics and cellulose esters will be in charge of William L. Searles. F. L. Bume will handle the recently introduced line of acetate dye-stuffs.

Warren Steam Pump Co., Inc., Warren, Mass., has made Gil Moore, 4031 Goodwin Ave., Los Angeles, its sales representative in southern California and parts of Arizona and Nevada.

Vanadium Corp. of America, New York, has moved Frank St. Vincent from Niagara Falls where he was connected with the operating department, to Pittsburgh where he will serve as sales engineer.

Allis-Chalmers, Milwaukee, has appointed J. L. Singleton manager for the 60 district offices of the general machinery division's sales department. Prior to this appointment, Mr. Singleton had been assistant manager of the steam turbine department.

F. J. Stokes Machine Co., Philadelphia, is now represented in the New England territory by Harold G. Roman of Portland, Conn.

Texas Gulf Sulphur Co., New York, has added A. Nelson Myers to its sales staff. Mr. Meyers had been with the Chilean Nitrate Sales Corp. He will make his headquarters at the main office of the company in New York.

The Niagara Filter Corp., Buffalo, has incorporated a Canadian affiliate, the Niagara Filter Corp. (Canada) Ltd. H. A. MacKenzie, 65 Charles Street E., Toronto heads the technical sales division of the Canadian company.

Chase Brass & Copper Co., Waterbury, Conn., has appointed Walter L. Smith as general works manager to succeed F. A. Jackle who has been elected a vice president.

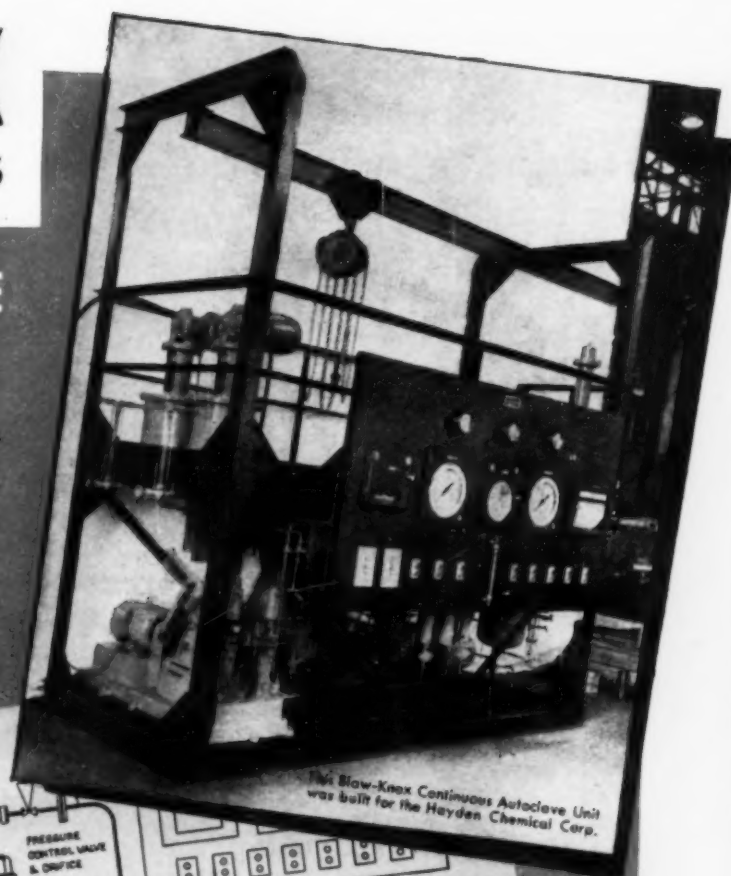
Westinghouse Electric Corp., Pittsburgh, has made H. Norman Miller manager for the company in the Portland, Ore., territory. He succeeds L. G. Fear who will act as the company's special representative in the Seattle and Portland areas.

BLAW-KNOX

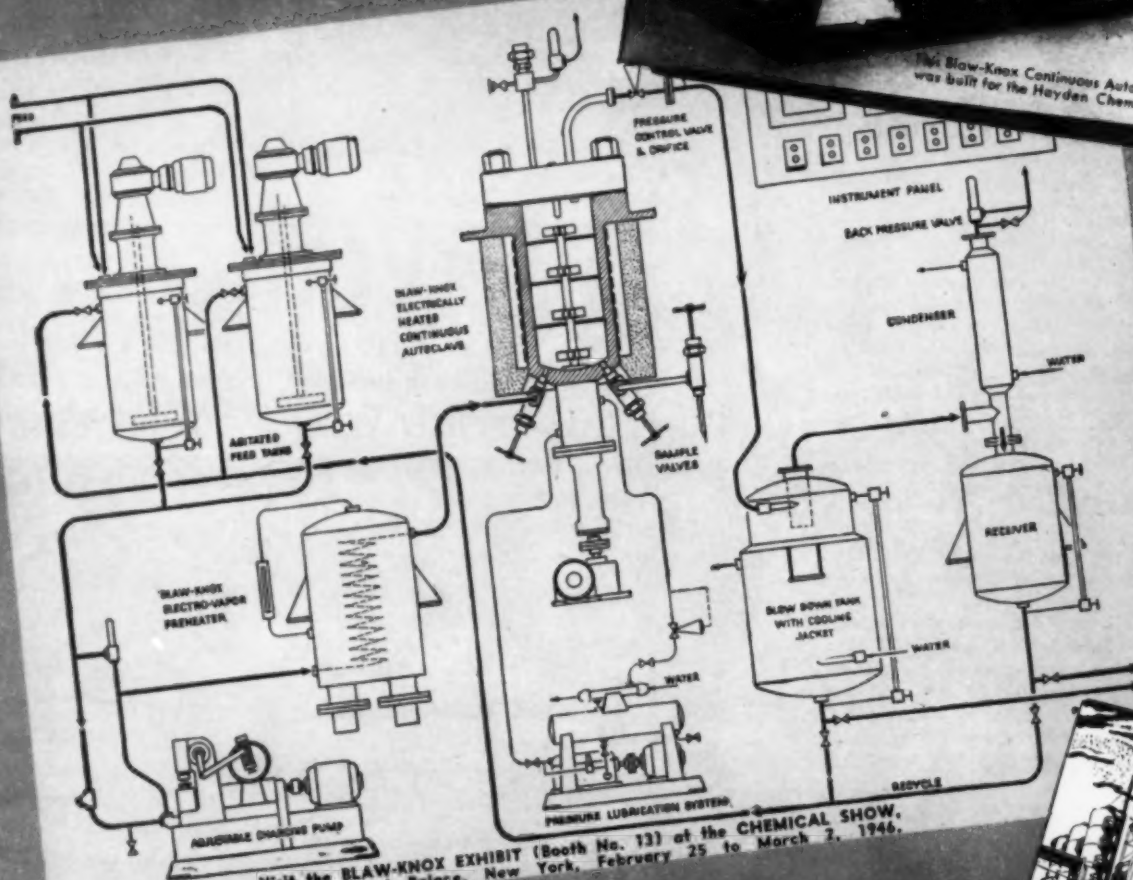
DESIGNS AND BUILDS

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By Henry
De Wolf Smyth

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FUTURE PRODUCTS FROM THE OIL FIELDS

AS CONCERNS the Southwest oil and gas country, four significant trends of the chemical industry are most important.

Many of the recently developed chemical products are new creations, not substitutes, as new and original as the invention of the light bulb, and with a field for exploitation almost as wide.

Many of these chemical products will enter the mass consuming markets, which require enormous tonnages of products, and

such markets are setting up an industrial demand for chemicals on a mass volume basis, compared to the relatively high-priced low-volume basis ordinarily considered as the chemical outlet of the past.

Most of the processes involved in producing these chemicals are adaptable to the use, all or in part, of natural gas, oil, or refinery gases as raw material.

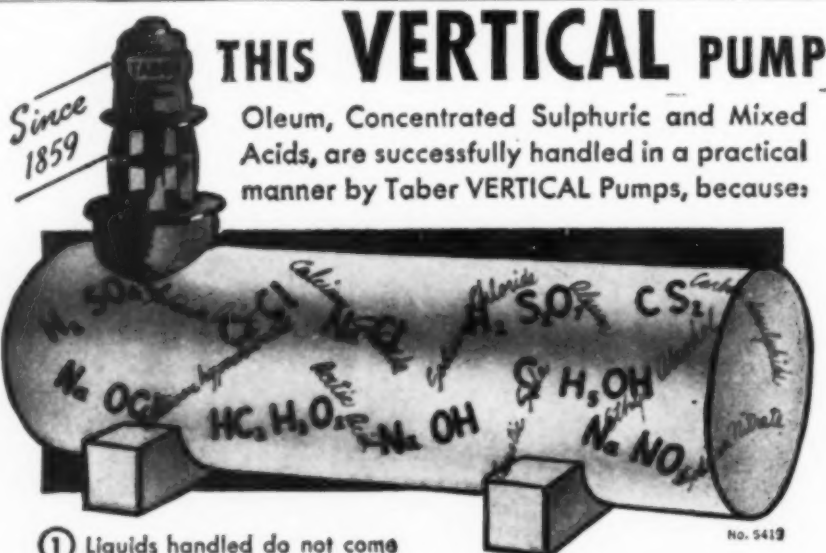
The relative purity of the petroleum hydrocarbons as ideal synthesis stock is attracting chemical industry to the Southwest. Properly exploited and cultivated, a wide variety of companion and complementary fabricating industries can be built up here to give a wider versatility than now enjoyed with oil, cotton and cattle.

H. P. Hohenadel, Cities Service Oil Co., before the Petroleum Division, AIME, Tulsa, Oct. 8, 1945.

ULTRAMICROCHEMISTRY

THE PROCESS for separating plutonium was without precedent from almost every standpoint. No one had ever seen any plutonium at the time that plant design was under consideration. The chemical properties attributed to the element at that time had been deduced solely from what might be termed secondary evidence—experiments on the tracer scale.

The novelty of the problem was enhanced by the facts that plutonium 239, the isotope or twin of plutonium desired, was to be the first artificially produced isotope ever seen, and that as an element it fell



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Sonneborn Petrolatums are readily available in three types — FONOLINE (soft), PROTOPET (medium soft), and PERFECTA (medium soft with high melting point). They are refined in a range of colors to suit various industrial purposes. Special types can also be made to individual specifications.

Sonneborn Petrolatums offer many interesting possibilities. Have our Department of Industrial Research tell you how one of these products can help you solve some current or future problem.

★ ★ ★

This is the second of two bulletins focusing industry's attention on the possibilities of Sonneborn Petrolatums for various processing or manufacturing operations. Reprints of the series will be supplied on request.

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beyond the confines of the classical periodic system. Moreover, both the plutonium and the fission products from which it had to be separated were present in only extremely small concentrations in uranium, so that new techniques were required, and the separation had to be carried out entirely by remote control because of the staggering levels of radioactivity associated with the fission products.

Because of the minute quantities of material involved, it was necessary to work with volumes of solutions and weighings on a scale of operation far below that of ordinary microchemistry. This new field of study has been named "ultramicrochemistry."

Special instruments had to be developed to deal with material in microgram amounts, a microgram being one millionth of a gram. An ultramicro-balance was designed which could weigh amounts as small as a microgram with an accuracy of three hundredths of a microgram (a ten-cent piece weighs about 2.5 grams, or 2,500,000 micrograms.) The beam and other operating parts of this balance are constructed of fibers of pure quartz ranging in diameter from about four times that of a human hair down to fibers which are invisible to the unaided eye.

So successful were these ultramicrochemical experiments, however, that it was possible to design and build a factory at Clinton, Tenn., and later a much bigger plant at Hanford, Wash., which produced plutonium on a large scale for military use.

It is self-evident that no one sees the plutonium as it enters the plant. It is also true that no one sees it until just before it finally emerges as a relatively pure compound. In the meantime, it has passed through a maze of reaction vessels via thousands of feet of piping with only instruments and an occasional sampling to chart its progress. It is a tribute to the care used in planning this vast undertaking that it has proved to be one of the safest of industrial projects.

In the future, when it will be possible to unfold a coherent account of the development, it will be seen that the manufacture of the atomic bomb involved the solution of an extensive list of extremely interesting scientific problems. This work will occupy an important place relative to the existing scientific literature.

Glenn T. Seaborg, University of California, before Illinois-Iowa Section, American Chemical Society, Rock Island, Dec. 13, 1945.

LIQUID-CHARGE TECHNIQUE IN TCC PROCESSING

As a means of conserving petroleum reserves and establishing well-balanced refinery operations, it is highly important to convert petroleum stocks into maximum yields of gasoline and light fuels and to minimize the production of heavy fuels. Over a period of years such processes as thermal viscosity breaking and coking have been developed for converting heavy fuel oils into gasoline and lighter fuels, but these methods have found only limited application due either to economic factors or limitations related to the quality of the products obtained. Catalytic cracking processes which have been installed on an enormous scale during the war, will serve to improve gasoline to

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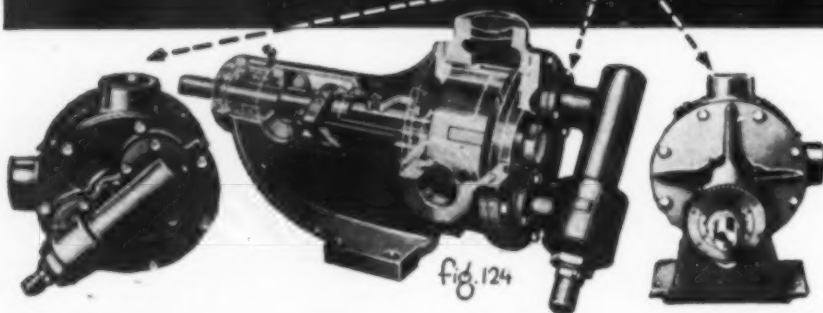
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heavy fuel-oil balance to a marked degree, because they produce high yields of high-quality gasoline with light fuel oil as a byproduct. However even catalytic cracking has been somewhat limited in application because of process limitations with respect to handling oils of high boiling point—with the result that, prior to the war and during the war, catalytic charge stocks had end points below about 1,000 to 1,050 deg. F. and dew points below about 850 deg. F. The latter limitation was made to facilitate maximum production of war products such as aviation gasoline from a minimum equipment installation.

Several months ago an adaptation of the TCC process was introduced for catalytic cracking of the heaviest types of petroleum charge stocks without restriction to boiling range, and converting them into high yields of high-quality motor gasoline and distillate fuel oils. The latter application of the TCC principle is referred to as "TCC liquid-charge technique."

The reactor used is the concurrent solid-bed downflow type with provision for introducing the feed at the top and removing the cracked products from the bottom. The charge may comprise total liquid or mixed liquid-vapor feed.

Catalyst-to-oil ratios need not be high to achieve the desired conversion with reasonable oil and catalyst inlet temperatures. Studies on a number of stocks show that catalyst-to-oil ratios of 1.8 to 4.0, by volume, are adequate. Overcracking may occur at higher catalyst-to-oil ratios, resulting in a rapid increase in coke and gas production with a loss in gasoline yield and liquid recovery.

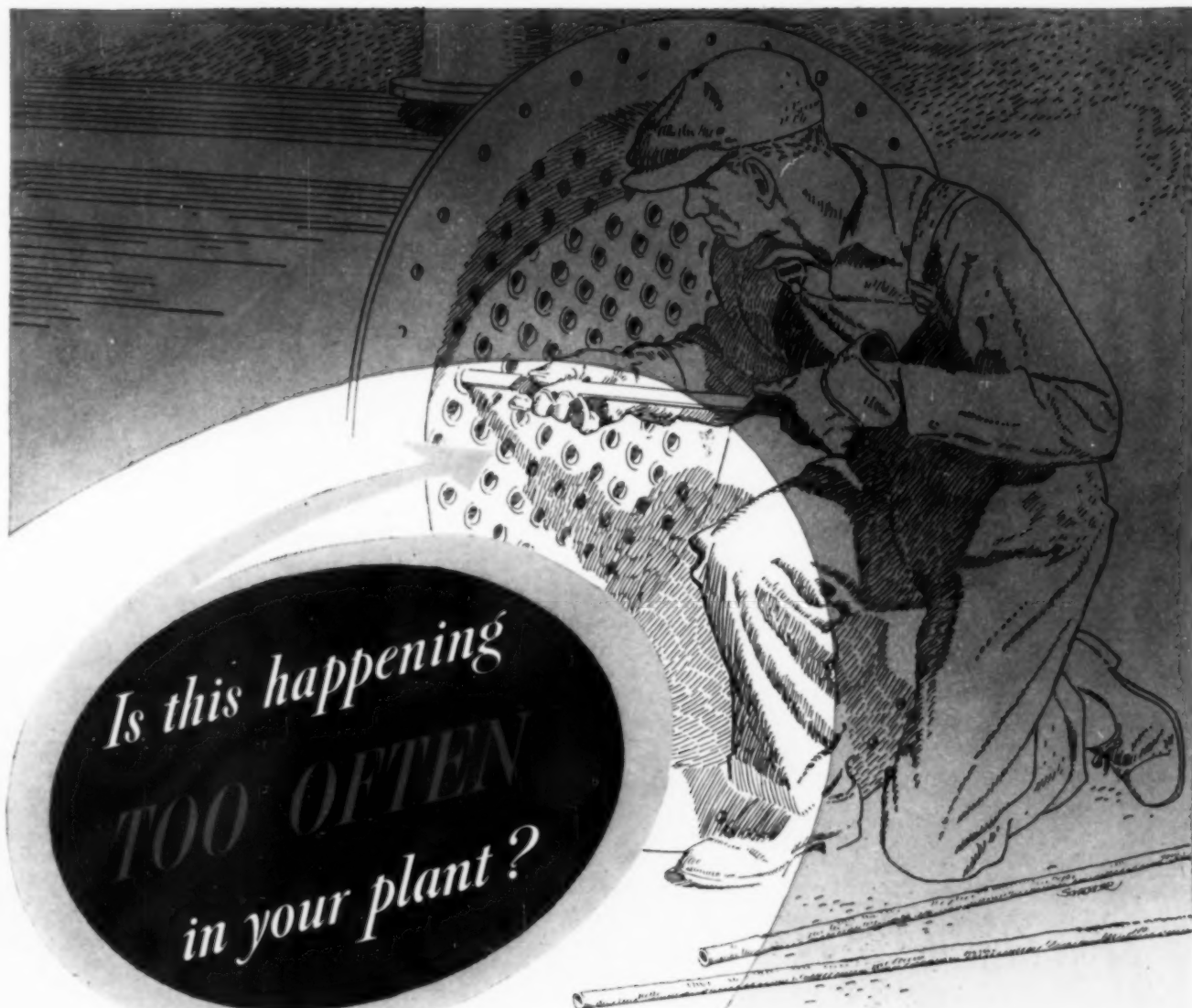
Charge stocks should be below about 4 percent by weight Conradson carbon residue to maintain coke laydown at reasonable levels. Heavy asphaltic stocks give excessive coke, and should be deasphalted before they are charged to the cracking unit. Deasphalting greatly reduces coke laydown, and results in improved yields of motor gasoline from a given capacity unit.

The catalytic reaction proceeds extremely rapidly, with about 70 percent of the cracking occurring at a point representing only 12 percent of the total path through the reaction zone.

T. P. Simpson and S. C. Eastwood, Soco-Vacuum Oil Co., and H. G. Shimp, Houdry Process Corp. of Pennsylvania, before American Petroleum Institute, Chicago, Nov. 15, 1945.

PRESENT AND FUTURE ATOMIC BOMBS

TO PRODUCE an explosion of an atomic bomb, masses individually below critical value must be brought together quickly. An efficient explosion requires that the parts of the bomb must not be separated appreciably before a large fraction of the nuclear energy is released. Thus two speeds are the controlling agencies: first, the rapidity with which the neutrons produce fission; and second, the rapidity with which the bomb components fly apart. The faster the former and the slower the latter, the more efficient the bomb. The efficiency is further improved by the use of an envelope or damper, and it serves two functions: first, it reduces the number of escaping neutrons; and second, by increasing the inertia, slows the rapidity with which the bomb com-



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ponents fly apart. At the maximum efficiency of 100 percent, the bombs as constituted at present produce 200,000,000 electron-volts per atom since only 0.1 percent of the mass of the uranium or plutonium atoms is converted into energy. If later, it becomes possible to completely change the mass of one atom of uranium into energy, 200,000,000,000 electron-volts per atom would be released. But, apart from this possibility, it appears certain that new and progressively more destructive atomic bombs will be made since in this respect, the world is at the threshold of an epoch and not at the end.

Col. Franklin T. Matthias and Major Frank A. Valente, Hanford Engineer Works, before Puget Sound Section, American Chemical Society, Seattle, Oct. 20, 1945.

ELECTRODEPOSITION OF METALS ON PLASTICS

The two main purposes for metallizing a plastic are: (1) To render it a suitable substitute for critical and strategic metals; and (2) to produce a product which has the inherent properties of the plastic in addition to the desired properties of the deposited metal.

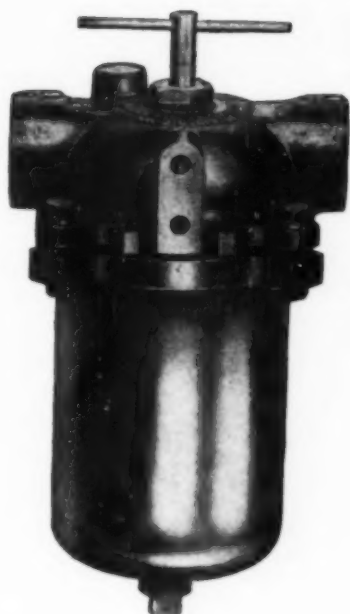
To render the plastic surface conductive, the methods such as those using fine metal powders in a lacquer or varnish medium, or metal spraying, or cathode sputtering, or metal evaporation, have proved successful but were found inadequate for the majority of production methods in industry. On the other hand, the chemical reduction method is best adapted to an economical production set-up. This method involves the application to the plastic surface (after proper preparatory treatment) of a conductive and adherent bond coat by using a solution of ammoniacal silver nitrate or other easily reducible metallic salt and a suitable reducing agent (usually organic), following by an intermediate layer of electrodeposited copper or silver, and finally by a top layer of the desired metal such as chromium, zinc, iron, lead, nickel gold, silver or cadmium.

Preparatory treatments of the plastic surface are the governing factors which make for success or failure of a process for plating on plastics, since the chemical structure of the plastic determines the procedure to be employed for the application of the conductive film.

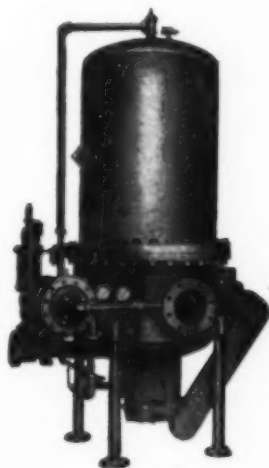
The two main advantages of the chemical reduction method, especially the process utilizing silver films, are: (1) The silver film covers the entire surface of the plastic regardless of its shape, so that proper electric contact is established over the entire surface to be electroplated; and (2) the thickness of the very thin silver film can be controlled so as to permit subsequent electrodeposition of an outer metal in accurately known thicknesses.

By plating on plastics, undesirable properties of the plastics, such as absorption of oils, solvents and moisture, which may cause swelling or distortion of the basis organic material, are eliminated by proper choice and thickness of the outer metal. The weatherability of the plastic is greatly increased. There is also an increase in tensile, impact and flexural strength and in resistance to abrasion and to heat distortion under heat.

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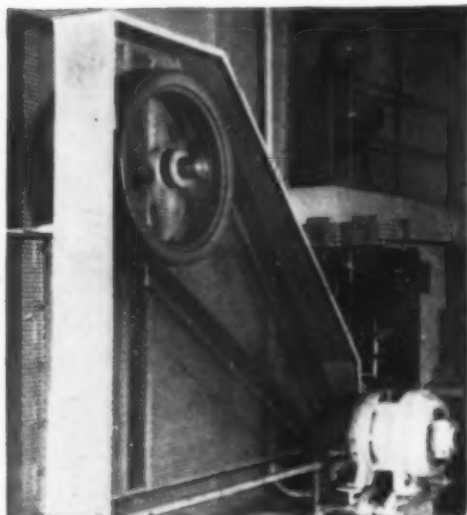
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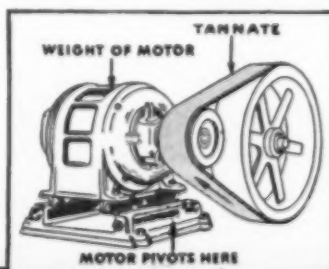
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this type of plating is the greater corrosion resistance of a metallic deposit when it is applied to a plastic material than to the usual metallic base. Resistance to salt water and industrial atmospheres is excellent since there is no electrolytic action. The inert, non-metallic plastic base insures a longer life of the outer metal coating and, hence, of the entire plated part.

Harold Marcus, Plating Process Corp., before The Electrochemical Society, Chicago, Oct. 5, 1945.

HOW TO MAKE PLUTONIUM

PILES are lattice works of uranium and graphite. If it were desired to produce a kilogram of plutonium per day, a chain-reacting pile would have to release energy at the rate of 500,000 to 1,500,000 kw. or approximately the power currently developed by the Grand Coulee Dam Station. To remove this quantity of heat, an efficient cooling system would have to be designed and built. In the case of the Hanford piles, water is used as a coolant, although helium was first considered.

Since uranium reacts chemically with water, it was necessary to either coat or jacket the pieces or slugs of uranium with a protective material such as aluminum. The problem turned out to be a very difficult one; but eventually, it was successfully solved.

The slugs remain in the pile for a definite length of time before they are discharged, a time determined by the amount of plutonium enrichment desired.

After they are discharged from the pile they are cooled in the radioactive sense, which permits a considerable amount of activity to decay in intensity. In due course, the discharged slugs are taken to a chemical processing area for the separation of plutonium from its uranium matrix, and from the highly radioactive fission products.

In the chemical processing, several grams of plutonium have to be separated from several thousand grams of uranium in addition to amount of fission products comparable to the quantity of plutonium present.

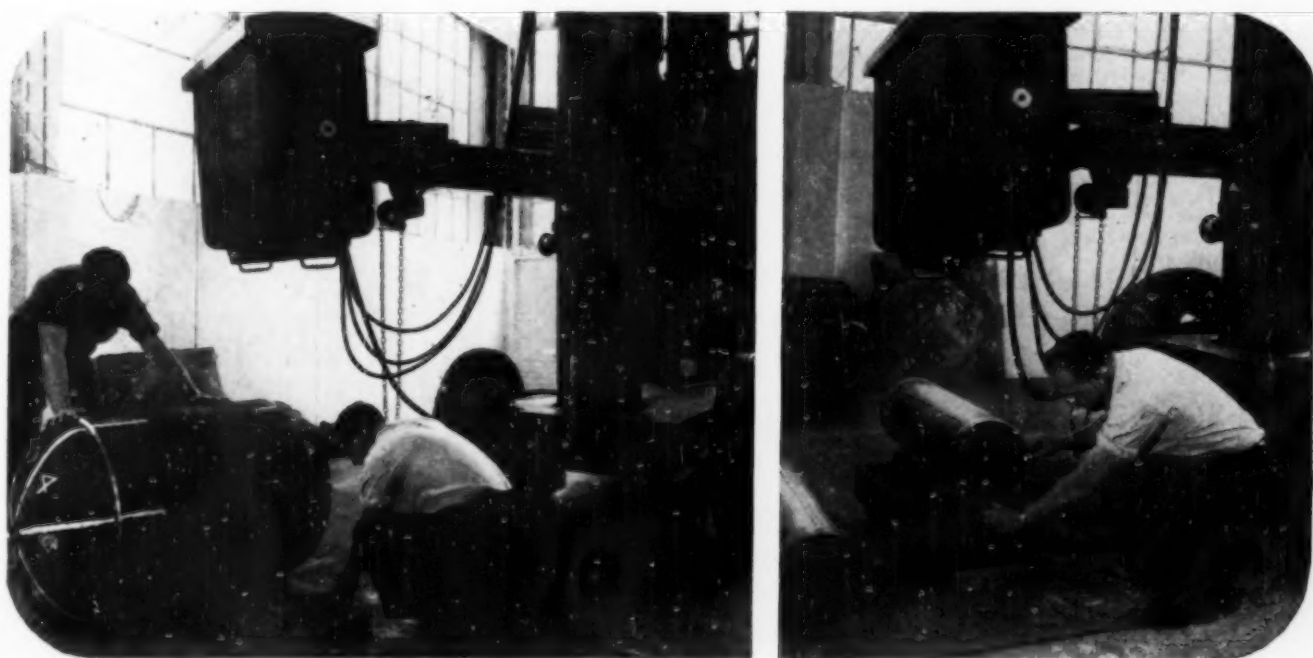
In radiochemistry, the method of carrier precipitation is frequently employed as the involved quantities are small; and this is essentially the Hanford method. Briefly, small concentrations of the same, or some other element, are carried down with the carrier precipitate. For example, radioactive barium is carried down with a barium sulphate compound.

The mechanics of separation are based on the alternation between the oxidation states of plutonium. In one state, plutonium precipitates out with a certain carrier. The precipitate is then dissolved, and plutonium is subsequently oxidized. Reprecipitation of the carrier compound then follows; and the plutonium remains in solution. A succession of oxidations and reductions result in the removal of the fission products. The degree of decontamination desired determines the number of oxidation-reduction cycles employed.

In June 1943, a decision had to be made on which process was to be used at Hanford in order to proceed with the design of the chemical plant. Several precipitation processes had been studied; and because these possessed both desirable and undesirable

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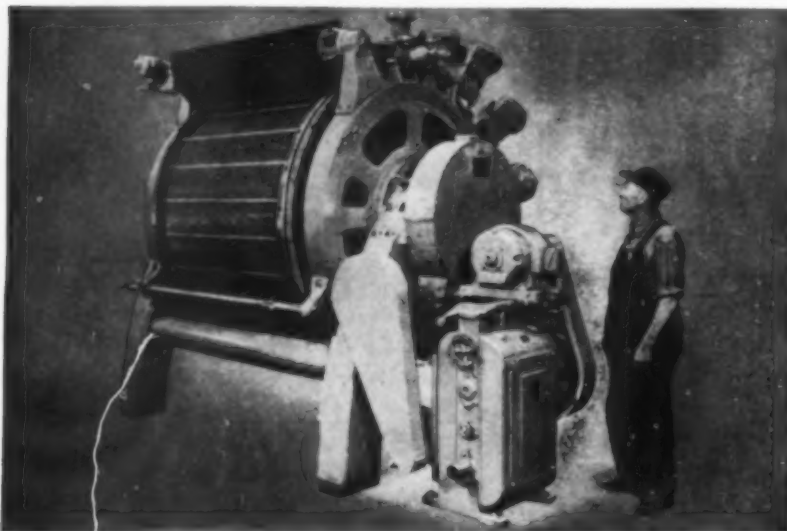
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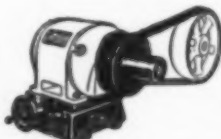
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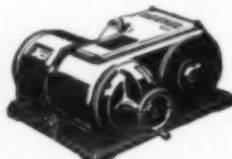
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features, it was decided to use a combination process which incorporated the advantages of each.

The process as finally chosen has exceeded expectations. The yields and the degree of decontamination obtained are high; and the choice, strangely enough, was based on chemical knowledge much of which was learned from much less than a milligram of plutonium.

Col. Franklin T. Matthias and Major Frank A. Valente, Hanford Engineer Works, before Puget Sound Section, American Chemical Society, Seattle, Oct. 26, 1945.

NITROGEN FIXATION AT ATMOSPHERIC PRESSURES

THE PROBLEM of nitrogen fixation has attracted the attention of a great many research men during the past half century. Particularly during World War I and for a decade thereafter, considerable energy was devoted to working out practical schemes for the utilization of atmospheric nitrogen. Processes for the formation of cyanamide from calcium carbide, of sodamide from metallic sodium, of alkali cyanides from alkali carbonates and carbon, and in particular of ammonia from its elements have attained some degree of usefulness in commercial practice. The arc process for the formation of nitrous oxide enjoyed a few years of life but is no longer in use in this country. Originally all these nitrogen fixation methods looked toward the production of nitric acid as the principal product. Today most nitric acid is made by the oxidation of synthetic ammonia.

In spite of all the past investigations on nitrogen fixation, no commercially operable process has appeared by which either cyanogen or hydrocyanic acid might be produced by a simple synthesis, cheaply and in quantity. Yet these cyanide compounds lend themselves admirably to the production of almost all of the simpler nitrogen compounds and intermediates.

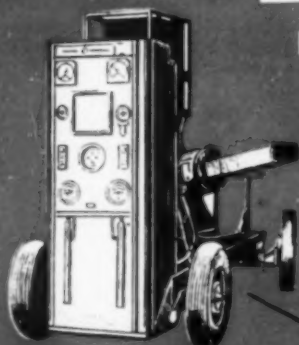
We investigated the direct synthesis of cyanogen and hydrocyanic acid with the view both of adding to the fundamental knowledge and of making a preliminary survey of the commercial possibilities of these reactions. Our experimental data were taken in apparatus which proved to be satisfactory for the data desired. Certain definite conclusions evolve from our work and are summarized below.

Cyanogen is formed when purified nitrogen is passed over heated carbon at temperatures of 2,200 deg. C. or higher and the cyanogen so formed may be determined in the reacted gases by chemical means. While the possibility of such a reaction has been pointed out on the basis of theories and calculations, there are to date no published accounts of cyanogen having been found experimentally by direct synthesis.

Cyanogen is formed when an electric arc is struck between carbon electrodes in an atmosphere of purified nitrogen. This reaction has been established by other investigators on the basis of spectrum measurements, but ours is the first recorded instance where cyanogen has been separated from the reaction products by chemical test.

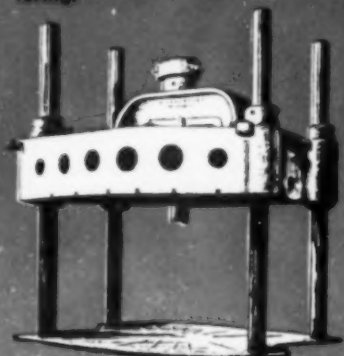
The cyanogen equilibrium has been measured at temperatures in the vicinity of 2,200 deg. C. Using our experimental data and published thermal data on cyanogen, we

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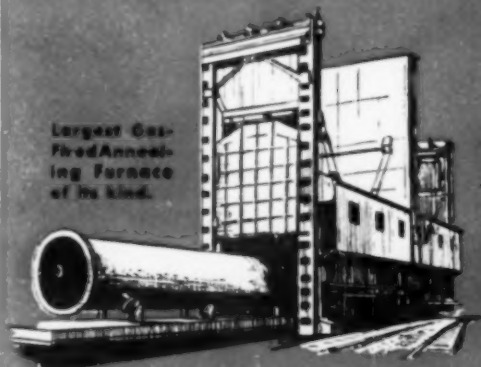
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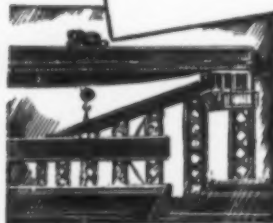
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have derived the following expression for the cyanogen equilibrium:

$$\log \frac{(C_2N_2)}{(N_2)} = -15,530/T + 0.855 \log T + 7.65 \times 10^{-5}T - 9.18 \times 10^{-8}T^2 - 0.50.$$

We are not able to conclude that the direct synthesis of cyanogen would be successful in commercial operation, but the apparent rapid rate of formation in the carbon arc is an indication that cyanogen can be produced by such a method.

Hydrocyanic acid is formed when carbon is heated in an atmosphere of hydrogen and nitrogen at temperatures of 1,600 deg. C. or higher. This fact verifies the work of several other investigators, but we have detected hydrocyanic acid at lower temperatures than heretofore.

The rate of formation of hydrocyanic acid has been found to be represented by:

$$\frac{d(HCN)}{dt} = k \frac{(N_2)}{(H_2)^a}$$

where the constant a is less than unity and is apparently influenced by the nature of the carbon. This constant is believed to have a true value of 0.5 for the type of carbon used in most of our experiments.

The results obtained in attempting to measure the hydrocyanic acid equilibrium indicate only that there may be some discrepancy between the calculations of other investigators and the experimentally determined equilibrium.

The real worth of our data to the engineer is to be measured by its applicability toward the development of a commercial process for the production of cyanogen or hydrocyanic acid. Some of our findings will be invaluable to the operation of a process for the direct synthesis of the cyanide compounds. Others merely indicate possibilities of carrying out the desired reactions in a manner not heretofore believed possible.

C. G. Fink, Columbia University, and D. M. Wroughton, Westinghouse Electric Corp., before The Electrochemical Society, Chicago, Oct. 5, 1945.

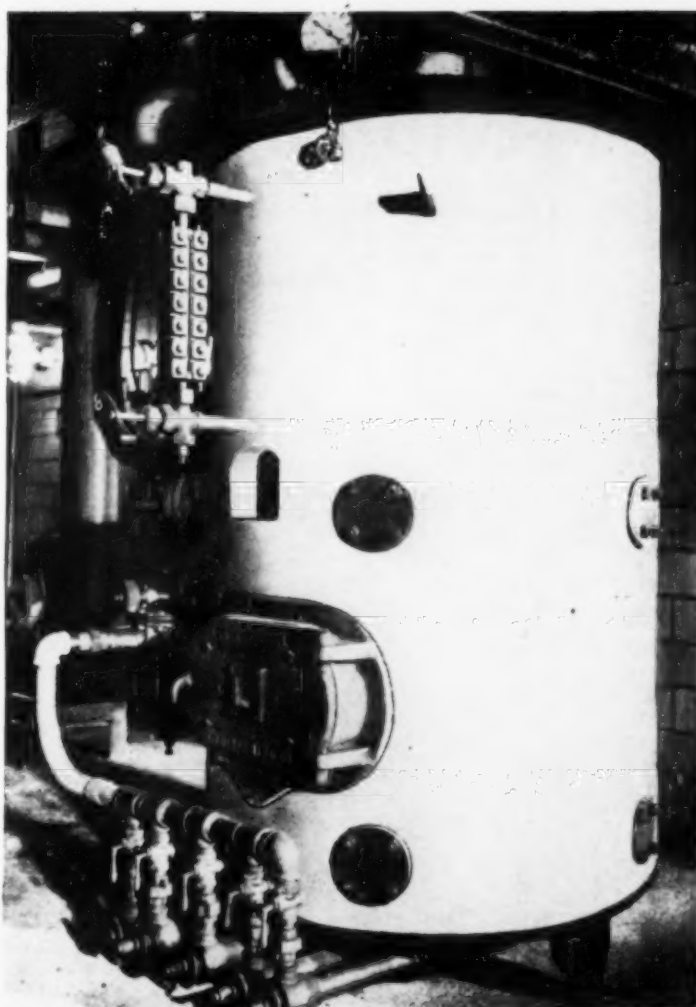
SUGGESTED LINES FOR PETROLEUM RESEARCH

It is essential that the petroleum industry exhaustively investigate new components and additives that will improve fuel quality and will help to provide better balance between high performance and production potential of our national resources. One of the more currently important phases of development will be to further explore the lean side of fuel grades, which is the fuel performance rating covering cruising powers and cruising range. This means that special effort should be made to improve the cruising or lean running quality of fuels, as well as maximum power or full rich quality, in order to obtain the ultimate in the critical performance characteristic of range in such of our postwar fighter and bomber aircraft as are powered with conventional reciprocating engines.

A practically new field has been opened to the industry in connection with fuel research and development for jet-propelled aircraft. Thus far we have generally used kerosene or gasoline operationally in jet aircraft. Extensive investigation is indicated to explore the optimum in jet fuels for our future air force which to a large

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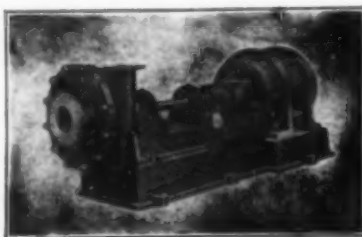
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Lt. Gen. James H. Doolittle, U. S. Army Air Corps., before American Petroleum Institute, Chicago, Nov. 14, 1945.

CHEMICAL NEEDS OF THE RUBBER INDUSTRY

PLASTICIZERS for natural rubber or synthetic rubber compounds are generally added for one of four purposes: (1) To plasticize the uncured compounds for processing; (2) to produce tack in the uncured compounds; (3) to produce a lower cured hardness; (4) to produce an improved low temperature flexibility in the cured product.

There is a limited field for cheaper softening agents in the oil-resisting types of synthetic rubbers. There is a field for the development of cold resisting plasticizers for natural and synthetic rubbers which, if satisfactorily covered, will result in wider and more extensive uses of rubber products.

In the classification of chemical plasticizing agents, we find a group of materials which produce a softening of rubber, either natural or synthetic, when used in relatively small amounts compared to the amounts of plasticizers customarily used. This field is a limited one which is fairly well, although not too economically, supplied from the materials at present available.

There is a definite need for an economical, non-toxic solvent with a non-objectionable odor and with desirable solvent efficiency for the oil-resisting synthetic rubbers. This is a real need and some compromises might be made in certain phases of solvent efficiency if such a material were available. If solvent efficiency proved to be good and the material were sufficiently economical, then there is little doubt but that its use could be extended to the much larger field of the non-oil-resisting rubbers, natural rubber, GR-S and butyl.

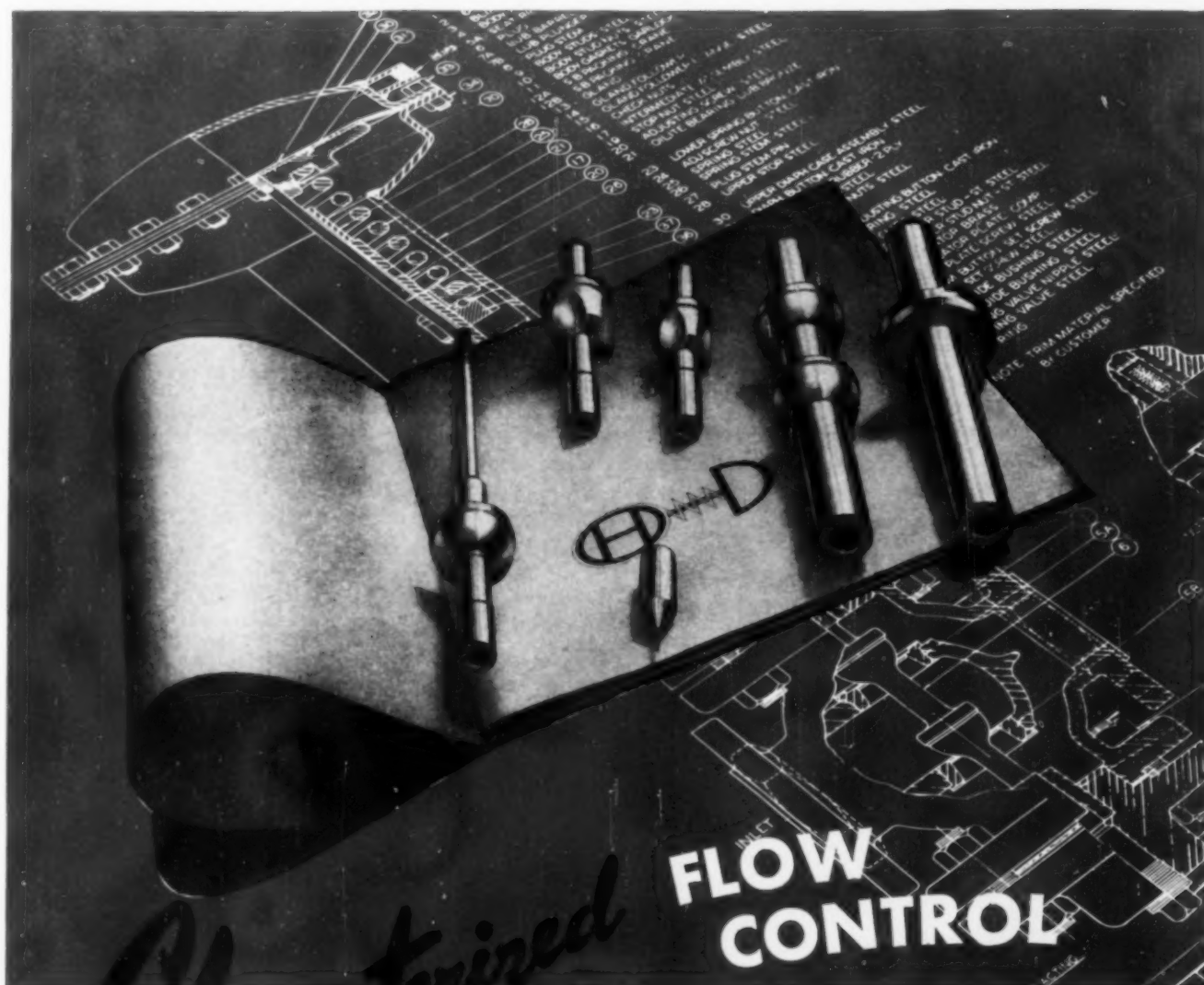
In most reclaiming processes two types of oils are used—one, a powerful swelling agent and, the other, a lubricating or softening agent. For natural rubber scrap, among the most commonly used swelling agents are coal tar naphtha and certain wood distillation products. Since it is necessary to use these materials in substantial amounts, and since approximately half of that used remains in the finished reclaim, it would be highly desirable if more potent materials could be found. This would permit the use of less of these materials and since less material would remain, the finished produce would be of higher quality and would give less trouble from "gassing" during further

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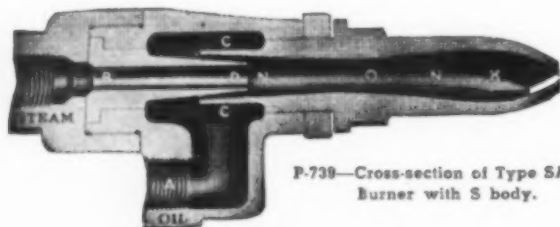
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processing and also, less odor in the finished products. A great number of materials have been investigated for this purpose, and if something substantially better than coal tar naphtha could be found, it would find acceptance as a swelling agent for natural rubber scrap in the reclaiming industry.

For the reclaiming of vulcanized GRS compounds, the same type of materials are used except that in order to obtain a smooth and satisfactory reclaim, it has been found necessary to use even greater amounts of swelling agents with the consequently less desirable effects upon "gassing" and odor. Therefore, an improved swelling agent for GRS scrap, of which there will be a great quantity in the future, offers even more promising commercial possibilities than one for natural rubber scrap.

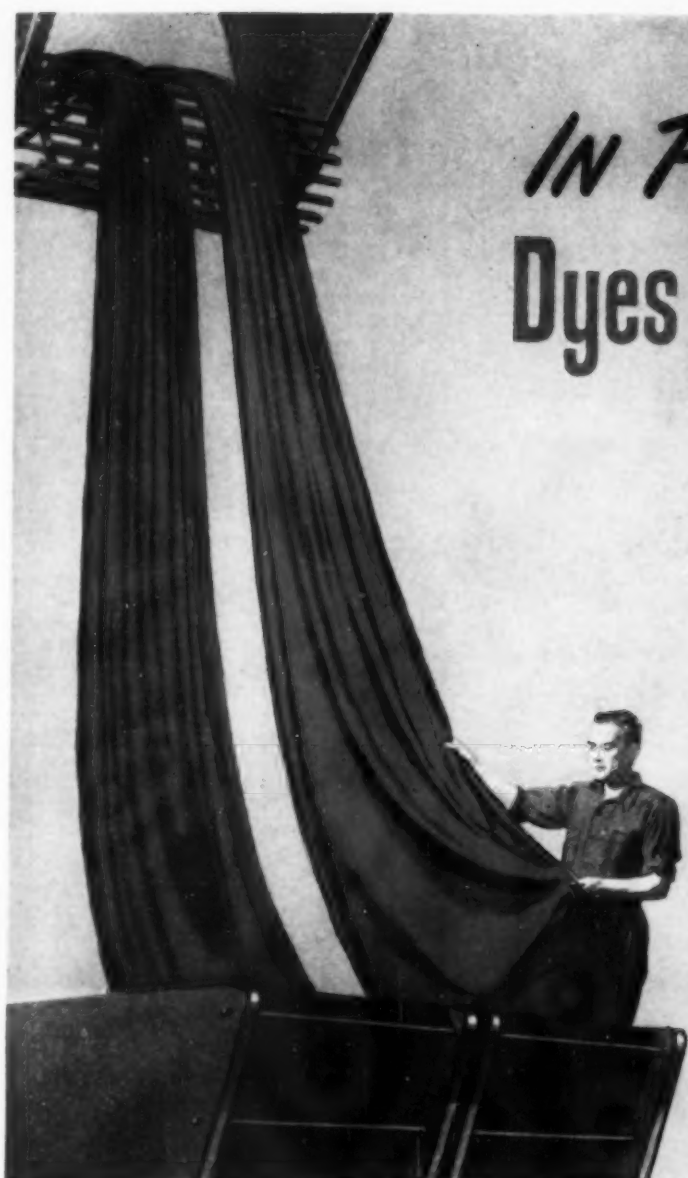
On reclaiming oils the most fruitful field of investigation is the development of more potent swelling oils for natural rubber and GRS rubber scrap. If a combination swelling and plasticizing oil is being manufactured, then the potency of the swelling component should be increased.

Pigments for the rubber industry fall into two general classifications: reinforcing pigments and diluent pigments or fillers. Pigments are available for practically all requirements at present under consideration. Large tonnages are involved and there is always the possibility of a small savings at equal quality producing a sizable over-all savings for a given period of time.

A complete line of accelerators is available covering satisfactorily all major requirements. With electronic curing and injection molding, where the stock is heated quickly to curing temperatures just prior to entering the mold, it is quite probable that delayed-action accelerators will find wider applications since large temperature gradients will not be a problem in the curing of thick sections.

The field of antioxidants, as such, also seems to be adequately covered. However, antioxidants have probably been used in greater tonnage as flex cracking resisters than as simple antioxidants and while this field has been extensively explored and while a number of effective products are available, there is always room for improvement. In the field of non-discoloring antioxidants for white or light colored stocks, the potency of the materials presently available does not measure up to that of antioxidants with staining or discoloring characteristics. More powerful non-discoloring antioxidants would be very desirable. Along the line of protecting rubber or synthetic rubber compounds, there is a definite need for better high temperature stabilizers.

It has been found that certain of the cement types of adhesives used for rubber to steel, particularly those containing chlorine derivatives of rubber, give trouble with deteriorating adhesion which results from rusting and corrosion when the parts are exposed to water or salt water under certain conditions. This will not be apparent in every application due to factors of design. Rubber is not completely impervious to water and where thin sections adhered to metal are exposed and where the section is under high stress, the deterioration of adhesion has taken place. The obvious procedure is to design around the difficulty by using thicker sections but this is not always



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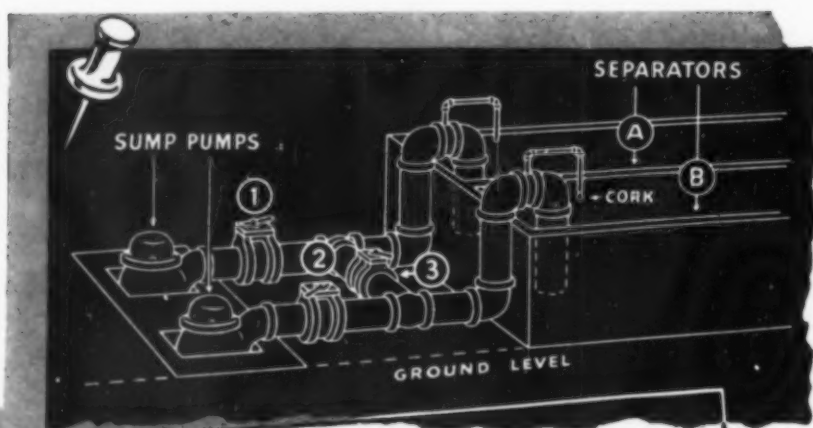
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possible and the problem is still there. A satisfactory solution to this problem would be a welcome one.

To summarize, there have been suggested two fields which would extend the useful temperature range of rubber products: (1) A more potent low temperature plasticizer or an improved low temperature polymer; (2) a high temperature stabilizer. These two materials, if found, would improve present service and would broaden the applications of rubber compounds.

There is a need for more non-toxic, effective and economical solvents for the oil-resisting synthetic rubber which, if sufficiently economical, have the added potentiality of being applied to the larger field of the non-oil-resisting rubbers. There is also a need for reclaiming oils with greater swelling power which will overcome present difficulties in respect to "gassing" and odor. With the changing picture in regard to available types of scrap, these problems will become more evident. In the field of chemical plasticizing agents, pigments, accelerators and antioxidants, our needs seem to be fairly well supplied. However, more powerful flex-resisters, more powerful non-discoloring antioxidants and better sun-checking resisters for certain types of rubber would be desirable.

M. J. DeFrance, the Goodyear Tire & Rubber Co., before Chemical Market Research Association, Cleveland, Dec. 13, 1945.

TOLUENE SYNTHESIS AND AZEOTROPIC RECOVERY

DIMETHYL-CYCLOPENTANE, methylcyclohexane, and ethylcyclopentane are the three chief "synthesis compounds" from which toluene can be synthesized in a hydroformer. Dimethylcyclopentane and ethylcyclopentane are five carbon ring naphthenes which are first isomerized to methylcyclohexane, a six carbon ring naphthene, and then dehydrogenated to toluene. Toluene is made up of the six carbon benzene ring with one of the hydrogens replaced by a methyl group. Going from the naphthene to the aromatic in the same boiling range, there is a decrease in gravity of between 25 and 40 deg. API.

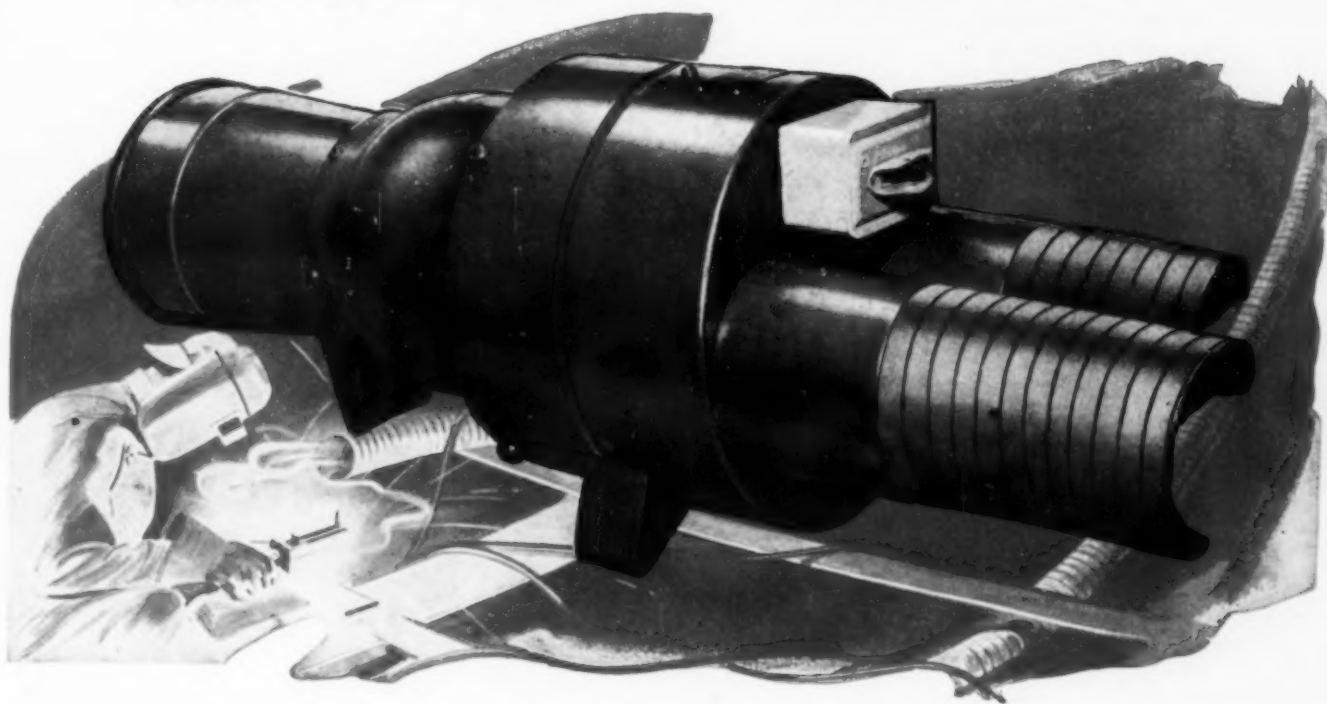
Normal heptane and dimethylhexane are two typical paraffin hydrocarbons contained in the feed stock along with the previously mentioned reactants. These compounds pass through the hydroformer reactor essentially unchanged and consequently contaminate the raw synthetic toluene hydroformate.

To remove these paraffins in the toluene recovery step, the azeotrope-former methyl ethyl ketone-water is used. This compound, an oxygenated derivative of butane, boils at 175 deg. F., considerably below that of the paraffins and toluene in the hydroformate. The constant boiling mixture (164 deg. F.), approximately 90 percent MEK, 10 percent H₂O, has the property of loosely combining and lowering the boiling point of the paraffins and naphthenes contained in the hydroformate and at the same time not affecting the aromatic toluene.

In order to include both the synthesis compounds and naturally occurring toluene in the feed stock, a fraction containing everything boiling between about 190 deg. F. and 256 deg. F. must be separated from both the straight run and natural gasoline. At Union's Los Angeles refinery this was ac-

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SINCE 1841 **Hicks**
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completed by first taking overhead in a crude tower everything boiling to about 235 deg. F. and then redistilling this fraction in a 50-plate tower, taking overhead everything boiling below 190-195 deg. F. and thus removing from the bottom a fraction boiling between 190 and 240 deg. F. ASTM. This operation, commonly called heart cutting, was also carried out at Union's Oleum refinery in order to make available the maximum volume of hydroformer feed stock obtainable from total crude and natural gasoline runs by the company.

Synthesis conditions in the commercial hydroformer are as follows: (1) Reaction pressure of 150-300 lb. (2) reactor charge temperature 1,000-1,070 deg. F. (3) wet gas recirculation (70 percent hydrogen) 6,000 cu.ft. per bbl. of reactor charge. (4) dehydrogenation catalyst consisting of 10 percent molybdenum dioxide on alumina at a space velocity of 0.6.

The commercial hydroformer is designed to run up to 9,000 bbl. per stream day of charge stock. Because it is necessary to regenerate the catalyst, multiple reactors are employed, and in the case of Union's hydroformer a total of six are used.

Two-pass hydroformate containing about 38 percent toluene now goes to the toluene recovery plant. Prior to the azeotropic distillation step, the hydroformate is cut to form as narrow a boiling range feed stock as is possible in order to reduce the methyl ethyl ketone-water azeotrope former requirements. This is accomplished by simple fractional distillation in two 40-plate towers, the overhead from the first being a pre-toluene or benzene fraction, from the second the toluene cut, and from the bottom of the second a post-toluene of xylene fraction. The toluene cut containing about 65 percent toluene is fed into the azeotropic tower along with the methyl ethyl ketone-water azeotrope-former. In the azeotropic tower the MEK-water mixture loosely associates with the paraffins and naphthenes and carries same overhead. The toluene, because of its higher boiling point, proceeds down the tower from the feed tray and is removed from the bottom as crude toluene. The crude toluene goes to a toluene flash tower from which overhead goes a small cut of toluene plus MEK, and out the bottom leaves an MEK-feed crude toluene. The crude toluene is treated with about 5 lb. per bbl. of 98 percent sulphuric acid, settled, water washed, and caustic washed to remove very small amounts of olefins to obtain color stability. The acid treated toluene is then redistilled to produce overhead finished nitration grade toluene.

When the charge stock contains 40 percent or more aromatics, azeotropic distillation is usually less costly than extractive distillation. An example of this somewhat similar process is the separation of toluene from non-aromatics using phenol as the extractive distillation agent. The chief difference between the two processes is that in azeotropicing a majority of the agent goes overhead with the non-aromatics and in extractive distillation a majority of the agent goes out the bottom with the aromatics.

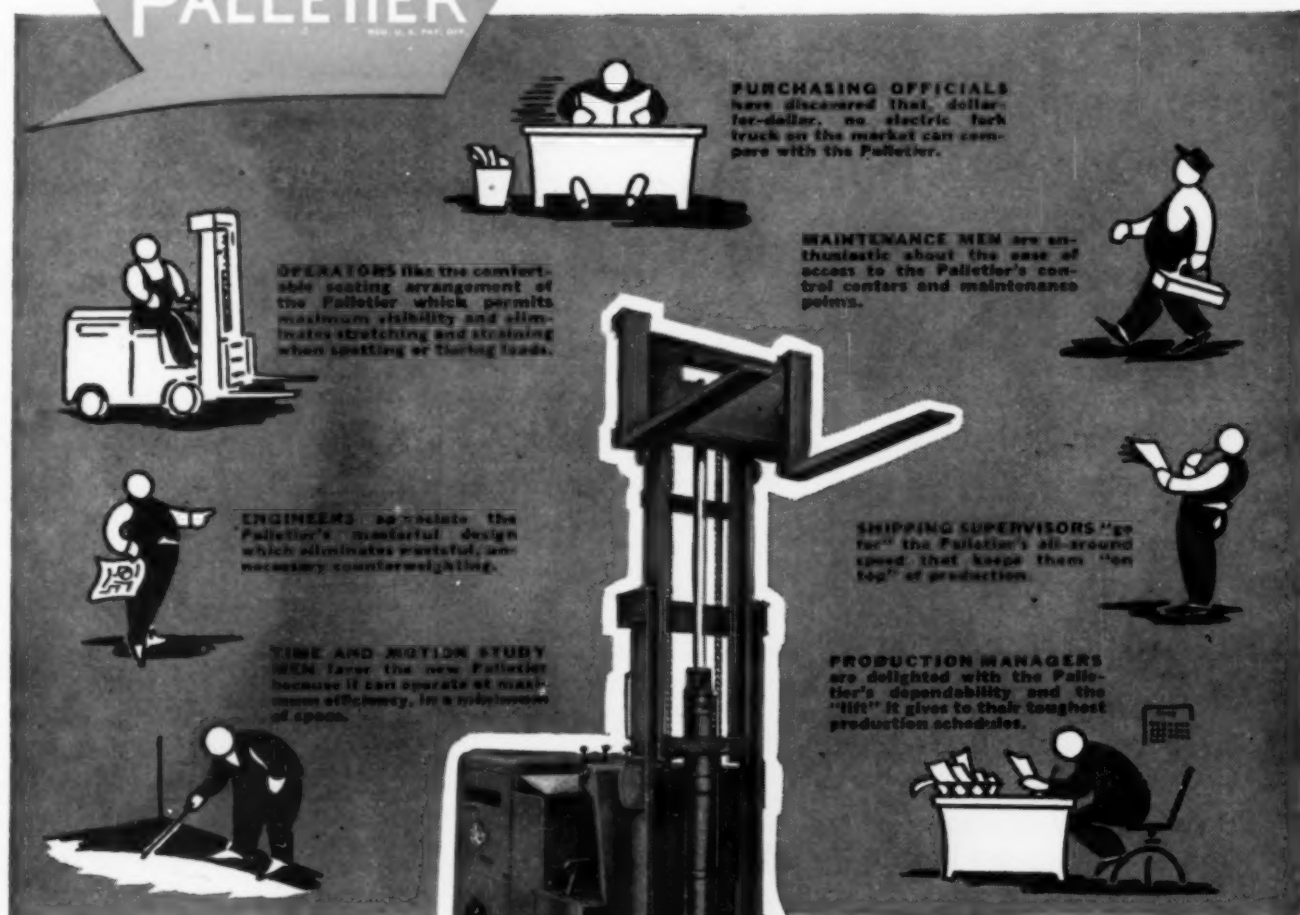
The field of application of the azeotropic distillation process should greatly increase as the petroleum and chemical industries increase their production of more and more essentially pure compounds. Certainly the

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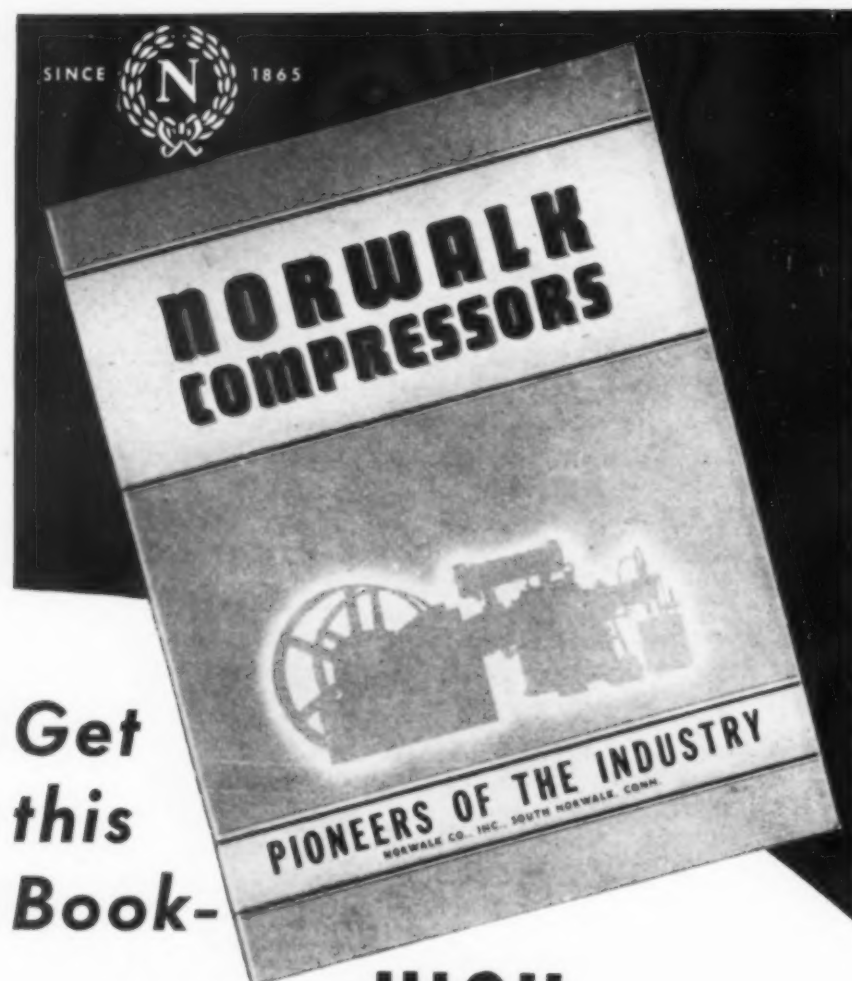
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production of aromatics by azeotropic or extractive distillation will continue. For separating toluene and xylene from non-aromatics, MEK-H₂O azeotropic former can be employed. For separating toluene from non-aromatics methanol can also be used. Acetone can be used as the azeotropic agent for separating benzene from non-aromatics.

Fred L. Hartley, Union Oil Co. of California, before California Natural Gasoline Association, Los Angeles, Oct. 12, 1945.

RECENT DEVELOPMENTS IN GLASS PIPING

It has been realized for many years that glass piping could be more widely used if it were more easily adaptable to field fabrication. While it may be easy to plan many installations so that all cutting and fitting can be done at the pipe factory, there are many others where the pipe must be made up as installation proceeds. Realizing this, a considerable amount of work has been done to find ways of cutting and flanging glass in the field. Two methods, now being perfected, show considerable promise.

The first scheme a procedure called pipe beading, was developed at the Corning Glass Works by Mr. R. L. Callard. Essentially, it consists in cutting the pipe to length with a hot wire and then applying a bead-like flange by heating and forming the end in a ring burner. This flange can be connected to the standard conical flanges or to other beaded flanges.

Steps in the pipe beading procedure are as follows: (1) Cut pipe to exact length needed with a hot wire cutter; (2) form the bead flange by heating the extreme end of the pipe in an intense, concentrated flame and then spinning the pipe on roller supports until the bead is thrown out by centrifugal force; (3) anneal the beaded end by holding it in a bushy flame produced by changing burner adjustment. The entire beading operation, including cutting and annealing, can be performed in about five minutes.

Kits for beading will probably be sold to pipe users but they may also be rented if this seems desirable. Cost of the kit has not yet been fixed but it will be low enough so that most small plants can afford to keep one on hand for occasional pipe work. Large plants could probably keep several kits busy if they used pipe extensively.

Since the beaded pipe joint requires a flexible molded gasket, it is restricted to services where moldable gasket materials are permissible. Gaskets being used now are made of buna S-1074, which is suitable for mineral acids (except HNO₃) and food products up to about 180 deg. F.

Operating pressures for beaded pipe joints are being limited to 25 psi. for normal service. Under certain conditions it will probably be possible to use them at pressures of 50 psi.

At present, flanges and beading kits are ready for 2-in. I.D. pipe. Later they will be available for 1, 1½ and probably 3-in. sizes.

It is believed that pipe beading will permit the chemical engineer to use glass piping almost as if it were conventional metal pipe. He will be able to carry a stock of 10-ft. lengths, fittings and flange sets. When he wants to put in a new line, or

LOOK at this Valve

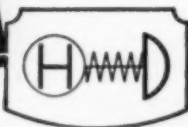


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It cannot discharge live steam even should water pressure fail entirely.

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add to an old one, he can take pipe out of stock and cut and fit as he goes along.

The second development concerns a method of fabricating conical flanged pipe in the field by means of semi-portable electric glass-working equipment that can be operated by ordinary mechanics with a small amount of training. Skilled glassworkers are not needed. This equipment is considerably more expensive than that for pipe beading and it will, therefore, probably be confined to plants where glass pipe is extensively used or where service conditions require the standard conical flanged joint throughout.

As with pipe that is to be beaded, 10-ft. long conical flanged lengths are delivered to the erection site. They are then cut to length with the hot wire device and conical flanges are sealed on to make the lengths desired.

The sealing operation is performed in a simple bench jig. Power for sealing is provided by a specially-built high frequency oscillator operating on the plant's 220 or 440-v. power system. Actual heating of the glass pipe ends is accomplished by warming them to a temperature where they begin to conduct electricity. Further heating is done by the high frequency electric current which is conducted to the glass by the needle flames used for preheating.

Because electric power heats the glass from the inside out, the sealing operation is simpler and the resultant joint stronger. If the seal were made in the conventional manner, with gas heat, skilled glassworkers would be needed. Annealing the electrically-made joint is a simple operation performed with a small electric oven that is clamped over the pipe.

A third development of interest to chemical engineers is a moderate size all-glass pipeline strainer capable of handling flow rates up to 60 g.p.m. of water. Pipe connections are of the conical flanged type and can be furnished in sizes from 1 to 3-in. I.D. The strainer screen is made of high silica glass by the multiform process. Free area is about 3½ sq. in. and the orifices are 0.030-in. slots. Pressure drop with water is about 6½-in. at 40 g.p.m. and 14 in. at 60 g.p.m. A transparent case permits observation of the screen during operation.

J. B. Blizzard, Corning Glass Works, before American Institute of Chemical Engineers, Chicago, Dec. 19, 1945.

IODINE COULOMETER

For the measurement of small quantities of electricity delivered by direct current, a coulometer is frequently required. This is especially true when the value of current varies too frequently to permit the use of an indicating instrument. While the silver coulometer gives greater accuracy, the copper coulometer is more frequently used because, with less care, it is satisfactory for most purposes. However for a large number of simultaneous measurements, the weighing of the electro-deposited metal becomes laborious. The oxygen-hydrogen coulometer is even less convenient.

It appeared that the use of a coulometer, requiring a simple titration, would be expeditious, and consequently the iodine coulometer came into consideration. The practical use of an iodine coulometer was investigated for the measurement of small

4 Hooker Metallic Chlorides of High Purity...

These four Hooker Chemicals are all classified as metallic chlorides, but they can't be grouped under one use or industry heading. Each one, a versatile tool for chemists, may be used in many different processes and in many different reactions. Whether you are looking for catalysts or highly active reagents; whether you are in the petroleum, the textile, pharmaceutical or even water supply field, it will pay you to see if any of these chemicals can help you. If the brief descriptions of these chemicals, their properties and uses whets your curiosity for more information, Technical Data sheets supplementing this data and including Hooker specifications of purity will be sent you when requested on your letterhead.

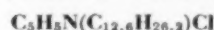
Aluminum Chloride, Anhydrous, $AlCl_3$ is principally used as a catalyst for Friedel-Crafts synthesis, polymerization, isomerization, halogenation. These reactions are important in the production of high octane gasoline, lubricants, synthetic rubber, dyes, pharmaceuticals, photographic chemicals, etc. Hooker Aluminum Chloride is a grayish crystalline solid which fumes in moist air. It is available in three sizes. It is a particularly pure product containing a minimum by weight of 99% aluminum chloride and a maximum iron content of .05%.

Antimony Trichloride, Anhydrous, $SbCl_3$ is used in the petroleum industry as a catalyst (with $AlCl_3$) to convert normal butane to isobutane and in various hydrocarbon oil treatments. It is also used as a catalyst in organic

synthesis; in the manufacture of dyes and pharmaceuticals; preparation of antimony salts; as a mordant in calico printing; in antimony plating; in bronzing iron and other metal treating processes. In a muriatic acid solution it forms a coating of antimony on iron retarding corrosion. Hooker Antimony Trichloride, Anhydrous, is a yellowish crystalline solid of 99% minimum purity. Iron and arsenic are present in a maximum amount of 1% and it is entirely free from lead.

Arsenic Trichloride, Anhydrous, $AsCl_3$ is used in the manufacture of synthetic organic chemicals containing arsenic for insecticides, war and police gases. The Hooker product is a clear, colorless to pale yellow liquid, containing 99.5% minimum, arsenic trichloride.

HOOKEER RESEARCH Presents LAURYL PYRIDINIUM CHLORIDE



This recently developed product of the Hooker Laboratories has already made its mark in many different applications. The textile field has put Laryl Pyridinium Chloride to work cleaning textile fibers, in water soluble lubricants, wetting agent in processing, color modifier in dyeing and as a cationic detergent, dispersing and wetting agent in rayon manufacture (Ref. U. S. Pat. No. 2,125,031). Like other quaternary ammonium compounds this chemical has good germicidal properties and is quite potent against both Gram-positive and Gram-negative micro-organisms. For the pharmaceutical industry, this chemical has many interesting possibilities in the preparation of antiseptic soaps, germicides, disinfectants, fungicides, insecticides, etc.

Among other suggested uses for this compound are the manufacture of foam resistant compounds, leveling agent in polishes and waxes; lubricant for plastic molds, additive to water to increase solubility of many organic compounds. Technical Data Sheet 745 gives physical and chemical characteristics and other information. A copy will be sent you on request.

Ferric Chloride Solution, $FeCl_3$ is used in sewage treatment, in photo engraving, for photogravure and heliogravure, as mordant in dyeing and printing textiles, for the manufacture of other iron salts, paint pigments, iron pharmaceuticals, as an oxidizing agent in making dyes, as a general disinfectant. It is a dark orange-red syrupy liquid with a Ferric Chloride content of 40 to 45% and a ferrous chloride content of .20% maximum.

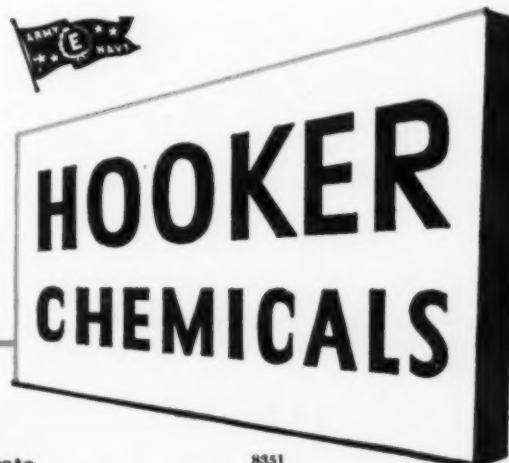
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currents of varying magnitude. It was found to be sufficiently accurate for our purpose without any special cell design. For any similar application where titration is more expeditious than the use of a balance, its use is suggested.

E. W. Belter, Westinghouse Electric Corp., before The Electrochemical Society, Chicago, Oct. 5, 1945.

FLAMEPROOFING COMPOUNDS

A GREAT deal of time and money has been spent by various firms to develop flameproofing materials particularly for textiles, paper, wood and other cellulose products. From the myriad patents and literature on the subject the rather startling fact emerges that very few new effective flameproofing agents have been developed. In fact the materials described used alone or in various combinations constitute the basic components in practically all flameproofing formulations. One reservation must be made: Owing to wartime secrecy orders, new effective flameproofing agents may have been developed during the present emergency which have not been reported in the literature.

Diammonium Phosphate—This salt is usually applied in aqueous solution by dipping canvas and other textiles to be treated. About 15 percent by weight of the cloth is required to give effective fire prevention and to prevent afterglow. Smaller amounts give protection of decreasing degree. This material has the disadvantage of being water soluble hence the fabric must be retreated after it has been wetted.

Diammonium Ethyl Phosphate—This salt is applied in the same way as diammonium phosphate and exhibits the same degree of protection. This material does not harshen the treated cloth as much as DAP and gives a better "hand." It is, however, more expensive and is also water soluble.

Boric Acid—Sodium Borate—This material is also applied in aqueous solution and requires slightly more than 25 percent by weight for fire protection. It does not eliminate afterglow.

Ammonium Sulfamate—This is one of the more recently developed flameproofing materials and is likewise applied in aqueous flameproofing materials and is likewise applied in aqueous solution, usually until 15-20 percent by weight is absorbed on the cloth. It imparts excellent flame resistance and fair afterglow characteristics. It is also water-soluble, however, and hence does not give a permanent treatment.

Chlorinated Paraffin and Antimony Oxide—This formulation possesses the advantage of water insolubility but is more difficult to apply to the fabric. It imparts excellent flame resistance, good waterproofing and fair afterglow properties.

Resin Impregnation—The use of fabrics impregnated with resins is another recent development of considerable interest. A number of new synthetic materials with good flameproofing properties have been developed within the past few years, and the application of these to flammable base materials, such as, for example, textiles and paper, is undergoing rapid development at the present time. Treatment with some of these compositions is permanent, the flameproofing action persisting even after numerous washings or drycleanings.

Proprietary Compositions—A large variety of proprietary mixtures have been marketed

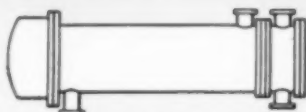
Design FEATURES



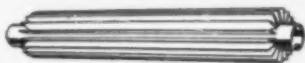
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Two G-Fin Sections of the same type are standard and interchangeable	Maintenance cost and expense of handling, installation are greatly reduced or eliminated, 100% savings value
G-Fin elements are made in only three diameters	Minimum inventory required for replacement parts
Design is suitable for practically all heat transfer services	Can be used for a wide variety of services than any other type of heat transfer apparatus
Heat loss shell diameter shell	High pressures are readily handled
Standard variants vary in weight from 100 to 1100 lb.	Easy to handle and transport
	General arrangements of installation is provided
	Elements are for more rugged than tubes usually used in shell-and-tube units
	For low cleaning time and maintenance expense as compared to shell-and-tube units
	Leakage and maintenance troubles from loose elements are eliminated
	Minimum possibility of leakage between flange
	The entire unit expands and contracts freely at the flange end

FEATURES	ADVANTAGES
The internal U-bend of the G-Fin element and the shell cover are independent of each other	Differential expansion of the G-Fin element and the shell is freely permitted
G-Fin elements are usually fitted external to the shell at the stationary end	Insulator of all G-Fin elements removable at stationary end
G-Fin elements may be provided with removable screw head or flange end	Insulator of G-Fin elements are true accessible at flange end as well as at stationary end
Each G-Fin element is surrounded by its individual shell	Uniform velocity of shell fluid throughout the entire length of the shell
G-Fin extend completely along the length of each shell	Continuous internal circulation
Uniform cross-sectional area of flow of fluids through element	Uniform velocity of flow
G-Fin elements and connections, no gaskets or covers	Complete
G-Fin have as to eight times as much area as the outside of the pipe to which they are attached	Pressure
G-Fin are embedded in the pipe by a mechanical process which forms a normally used and permanent bond between fin and pipe	Yield
Standard G-Fin elements weigh from 15 to 250 lb.	Insulator
G-Fin elements are 1/4 in. to 1 1/4 in. over pipe size	

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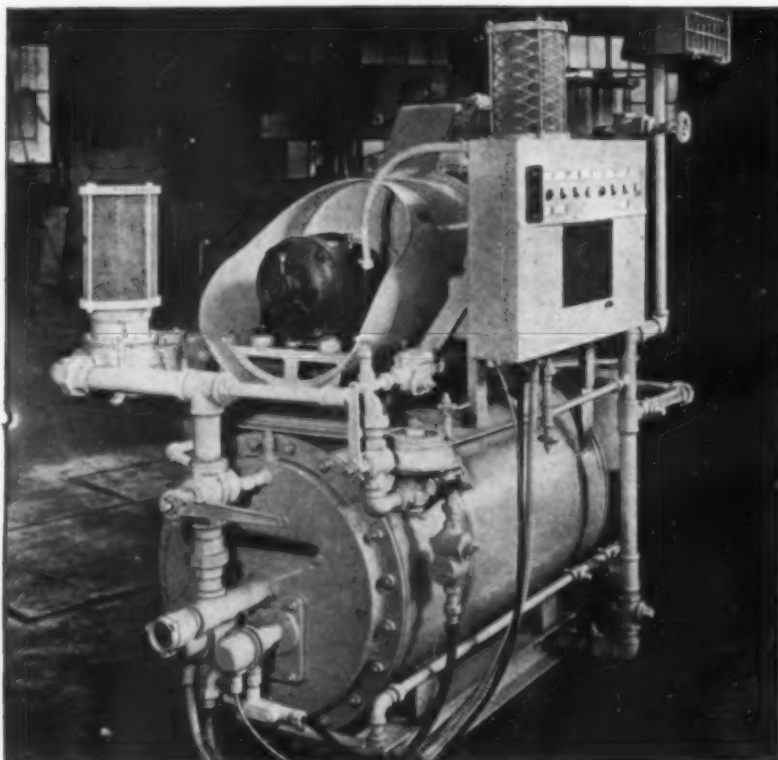
21 Features are responsible for this remarkable success of the Twin G-Fin Section. To mention only a few: great adaptability, interchangeability, freedom from leakage, sturdiness, convenience of handling, ease of cleaning, low maintenance expense. You'll find a detailed description of the Twin G-Fin Section—showing all its features and advantages—in our Bulletin 1613. Send for it today!

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for fireproofing nearly any base material. Some of these are really quite effective and others are nearly worthless. Since compositions vary greatly, no generalizations can be made, and it is necessary to test materials of this type carefully, under the intended conditions of use, to determine whether or not satisfactory performance may be expected of them.

The foregoing materials and ammonium chloride are also used to some extent for impregnating wood to give flame resistance. To force the material in the structural interstices of the wood suitable equipment for alternately applying vacuum and pressure has been developed. In the case of wood, since only the surface layer must be protected, about 10 percent by weight of flameproofing agent is required. It should be pointed out that, except for special cases, the cost of treating wood in this manner is relatively high at present.

In many formulations, other materials besides the basic components described above are also added. These include: ammonium sulphate, ammonium carbonate, aluminum hydroxide, zinc sulphate, magnesium sulphate, sodium phosphate, zinc chloride, urea and others.

Finally it must be stressed that while materials treated with these agents are flame resistant as tested by standard methods, they are not fireproof in the sense of asbestos and all will burn if heated to high enough temperatures. The effect of the flameproofing agent, therefore, is to greatly reduce the rate of combustion of the treated material and to reduce afterglow to a minimum.

E. G. Fordyce, Monsanto Chemical Co., before Ohio Fire Chiefs' Association, Columbus, Oct. 19, 1945.

ELECTROSTATIC DETEARING AND SPRAYING

ELECTROSTATIC "detearing" and electrostatic spraying are two new methods of applying finishing materials which are successfully being used in several fields and hold promise of wide application.

Electric "detearing" supplies an automatic method of freeing the piece of excess material after dipping and so presents to the oven a uniformly coated piece which can be adequately baked to a uniformly satisfactory finish.

In this process, the article supported on a conveyor is dipped or flow-coated in any suitable manner. It is then carried over the usual drain board and is permitted to "air dry" or "set" sufficiently so that the flow has practically ceased. At this point the grounded article is carried over an insulated conducting grid to which a high voltage can be applied. A strongly attractive electrostatic field is thus established between the grounded piece and the high voltage grid. This force is particularly strong at points or prominences where drain-off is apt to occur. Due to this attraction the excess paint which has collected at the drain-off points is removed from the piece and a smooth coating remains. The article can then be carried through the oven where baking can take place at a schedule more suited to the piece as a unit.

There are certain items that lend themselves more readily to spraying methods. However, the usual operating procedure is

ACTUAL TEST

SIMULTANEOUS DISINTEGRATION OF DE-WATERED PULP WHILE THOROUGHLY MIXING WITH FRESH BLEACH LIQUOR IN A CONTINUOUS OPERATION

THE JOB: New England Paper Mill required a high capacity shredding mixer to reduce process time in multi-stage bleaching of 15% consistency soda pulp stock.

THE EQUIPMENT: Sprout-Waldron 12-ft. covered steel mixer, ruggedly built for continuous service with high speed double agitator system designed to provide shredding with mixing.

THE RESULT: More than 10 years of continuous 24-hour per day operation with original agitator assembly still in use; rates as high as 6.7 tons per hour with a 30 HP motor; unit actually outlived original bearings; mixing and subsequent contact time significantly reduced.

IT'S REMARKABLE HOW A SUCCESSFUL INSTALLATION LIKE THIS WILL SUGGEST ONE'S OWN SIMILAR PROBLEMS.

FROM THIS YOU WONDER...

IN WHAT OTHER INDUSTRIES ARE SPROUT-WALDRON MIXERS REPRESENTED? A complete list would fill this page! But units serving such fields as chemicals, plastics, dyes, foodstuffs, pharmaceuticals, powdered metals, detergents, cosmetics, and insecticides leave no doubt about the versatility of their application.

DIAGRAMMED THINKING means common sense analyzing before reaching a conclusion . . . the pick-it-up, study-it, cast-it-aside or adopt-it method. Study these actual mechanical preparation tests from S-W's files this analytical way . . . and write us to determine whether this equipment can be "adap-tioneer" to solve your mechanical preparation problems!

I MIGHT NEED TO COMBINE MIXING WITH OTHER OPERATIONS . . . You'll find Sprout-Waldron facilities equally thorough and versatile for size reduction, screening, and materials handling. Our engineers specialize in efficient processes combining these functions in modern dust-free installations.

Here's how we work. You submit the essential details of your problem, and we recommend equipment based on an existing installation or incorporate a known principle into a unit of more suitable design. This we call "adap-tioneer." If warranted, preliminary tests may be undertaken at the Muncy laboratory.

Address "Dept. C" in submitting your preparation problems to us.

SOMETIMES STORAGE IS AS IMPORTANT AS MIXING . . . The Sprout-Waldron vertical mixers were originated to meet this condition with a minimum area requirement.

HOW WOULD YOU THOROUGHLY BLEND FINE POWDERS? The Sprout-Waldron Intimate Blending principle is generally the ideal recommendation, even when liquids or fibrous ingredients must be included as well.

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SUPPOSE I MUST MIX REACTIVE MATERIALS? Sprout-Waldron engineers will recommend stainless steel, a nonferrous alloy, enameled interiors, or even wood construction. Outboard bearings, heating and cooling jackets, dust-tight and water-tight outlets can also be provided when required.



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wasteful of coating material and methods have constantly been sought whereby spraying efficiency could be improved. The application of electrostatic principles has resulted in improved coating technique.

In this process the article to be coated is carried past the spray position on any of the usual types of conveyors. At the spray position, insulated electrodes composed of fine copper wires are rigidly supported in a plane at a fixed distance away from the article and have a high voltage electrostatic charge applied to them. The finely atomized paint particles which are sprayed into this field

from fixed guns experience a strong force of attraction to the piece and are deposited on it. The resulting coating is extremely uniform and, because practically all atomized particles experience this force regardless of their direction of travel from the gun, the piece is coated at very high efficiency.

The degree of savings possible is largely dependent upon the shape and size of the piece being coated.

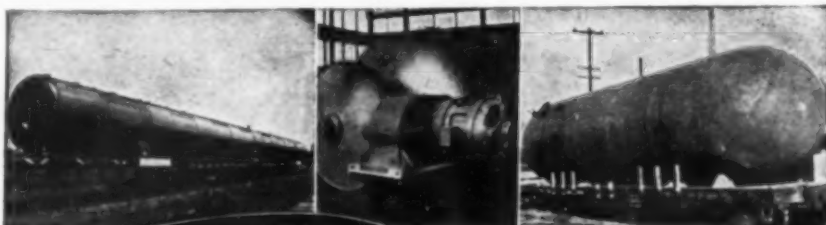
H. Ransburg, Harper Ransburg Co., before Cleveland Section, The Electrochemical Society, Sept. 22, 1945.

FOREIGN LITERATURE ABSTRACTS

DETERMINATION OF DRY RESIDUE FROM SALT SOLUTIONS

DETERMINATION of the dry residue in salt solutions by direct evaporation, without addition of anything else, is difficult because the calcium and magnesium chlorides usually present in such solutions form a series of hydrates which are difficult to dry and are partially decomposed by hydrolysis. This difficulty is overcome by evaporation of the given solution with sodium carbonate. The latter reacts with the salts of calcium and magnesium with the formation of simple and double insoluble carbonates and this protects the dry residue from decomposition by raised temperatures so that it can retain a constant weight. This method, however, has four disadvantages: (1) Necessity of first keeping the mixture to be dried at a comparatively low temperature (60-80 deg.) since otherwise the mass will spatter. The

necessity of using a large quantity of soda (2-2.5 times the quantity of the weight of the dry residue) often makes the container crack at a high temperature; (2) the high hygroscopicity of the dry residue which makes necessary repeated dryings and weighings; (3) the soda necessary for the work, due to its hygroscopicity, must be dried directly before the experiment or else be stored with certain precautions; (4) the soda method is not suitable in the determination of dry residue in solutions which contain hydrolyzable salts, whereas the salts of practically all the metals except those of the alkali and alkali earth groups are hydrolyzable. It was therefore decided to replace soda by another compound, such as sodium fluoride. The latter was chosen because fluorine ions bind the ions of calcium and magnesium into non-hydroscopic compounds similar to the carbonates of those metals but



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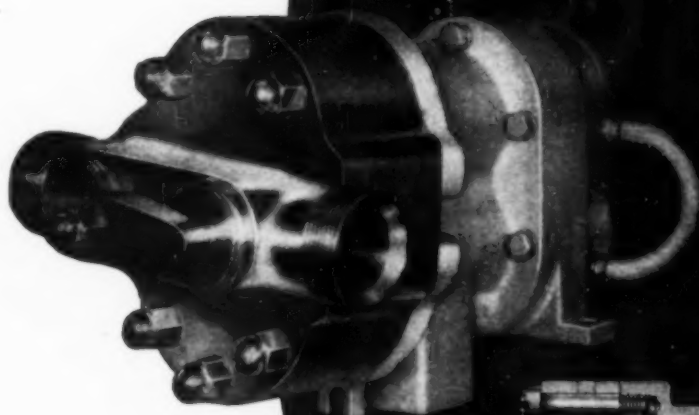
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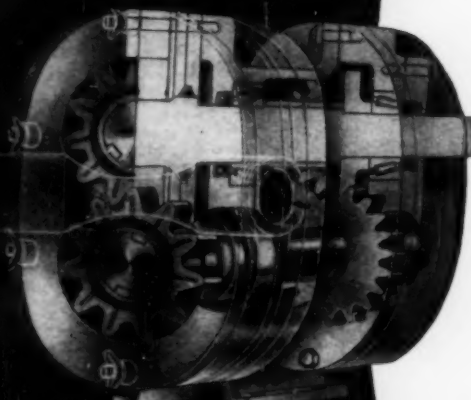
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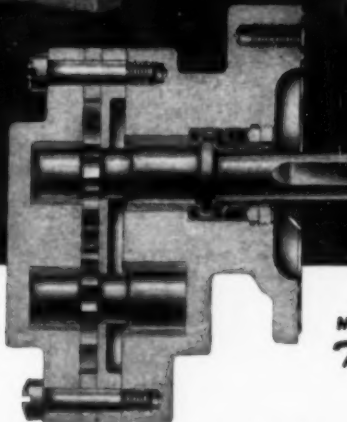
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WHICH OVERCOME USERS' OBJECTIONS TO
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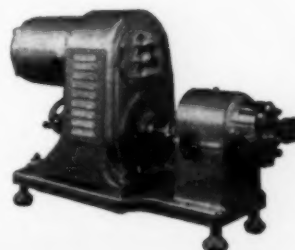


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more stable at high temperatures and less soluble. Sodium fluoride is anhydrous, non-hygroscopic and can be prepared readily and in sufficiently pure form. This method was found very satisfactory and can be applied in cases where soda may be unsuitable due to its decomposition which takes place in the presence of hydrolyzable salts in the product being tested.

Digest from "New Method for the Determination of the Dry Residue in Waters, Brines and other Salt Solutions" by I. V. Tananaev and M. L. Levina, *Zhurnal Prikladnoi Khimii* XVII, No. 6, 356-361, 1944. (Published in Russia.)

THERMOSTABLE PLASTICS FOR USE IN THE FOOD INDUSTRY

DUE to war conditions the food industry has had to turn to metal substitutes for containers. It was particularly important that these materials have high mechanical resistance as well as resistance to attacking chemicals, especially organic acids produced during fermentation or decomposition, and to the products used in cleaning and disinfecting the apparatus. Vinidur, made from polyvinyl chloride, is a synthetic substitute which is available in various shapes and satisfies the requirements of mechanical and chemical resistance. It is odorless and tasteless, harmless to the human organism and is really an ideal substitute product for the food industry. Transparent Vinidur MP can be used between -10 and 40 deg. Products like soft rubber, obtained by polymerization of isobutylene (Oppanol) also give good results and have pretty much the same advantages as Vinidur. The range of plasticity is greater and it can be used between -30 and 60 deg., or even greater extremes if the proper precautions are taken. Sheets of Vinidur and Oppanol are used to line the interior of containers in the milk industries and by manufacturers of fruit juices. These industries also use tubes and pipings molded from these products. The sheets used have a thickness of 0.8-1 mm. for Vinidur and 2-3 mm. for Oppanol. The usual method is to replace sheet metal by terne plate coated with a fine film of polyvinyl resin which can be bent, cramped, etc. Canning tins made like this can withstand prolonged heating at boiling. Very light sheets of Vinidur are used for wrapping food products. Vinidur tubes are made in three grades which resist, respectively, ordinary pressures of 2.5 atm. and 6 atm., at 40 deg.

Digest from "Use of Thermostable Plastics in the Food Industries" by A. Strot, *Plastiques* 2, 181, 1944. (Published in France.)

OXYGEN ELIMINATION FROM WATER

WATER used for feeding boilers must be as free from oxygen as possible to avoid corrosion. Removal of oxygen by cathodic reduction is an inconvenient method since it is difficult to separate the anodic and cathodic processes. Moreover, as the oxygen content decreases in the solution, its rate of reduction falls in proportion and a very large electrode surface would be required for completion of the process. The problem can be solved satisfactorily by combining cathodic reduction with some general process which would take care of the absorption of the last quantities of oxygen contained in the water. A process would be desirable which would

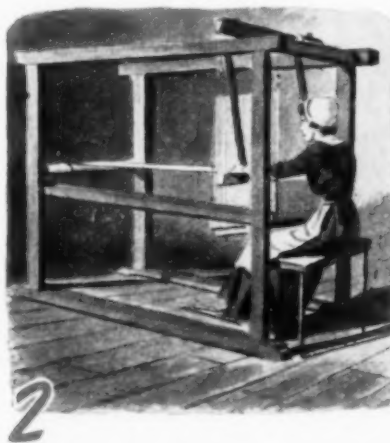


Old Reliable Red Band Says—

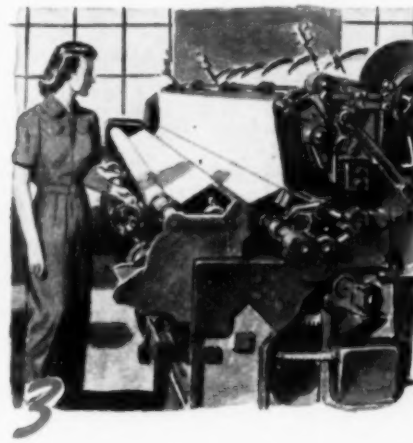
*"An ancient Greek
called the turn"*



When an ancient Greek philosopher once predicted that "Human slavery will continue until the loom weaves of itself," he really called the turn of important events to come. Events destined to free men from slavery . . . cut the costs of goods . . . raise the standard of living—



In early colonial days in our country, our forefathers were still spinning and weaving by hand, as the early Greeks did, to make clothing for the family. The driving force that was to mark another important milestone in man's progress, was still to be discovered—



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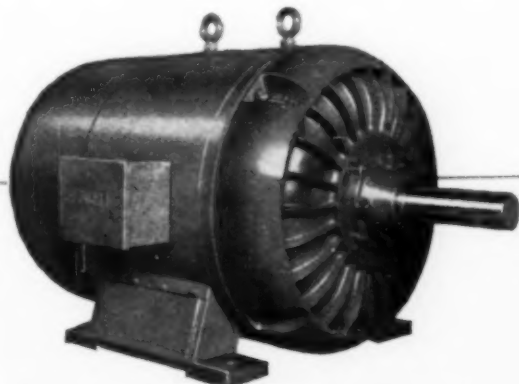
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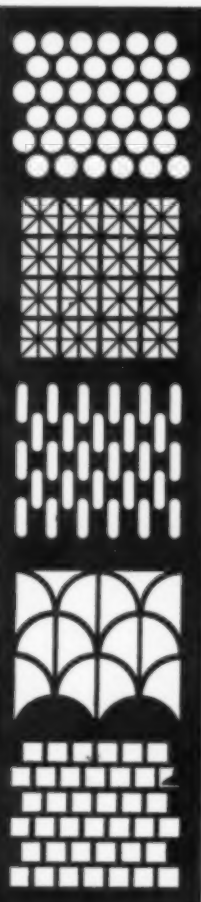
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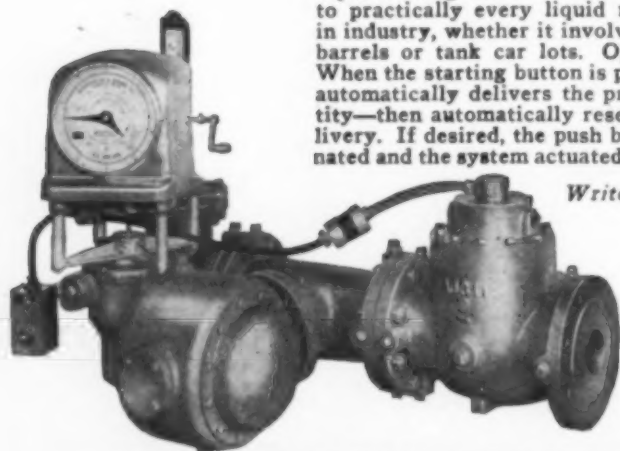
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Write for Bulletin F-42



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take place directly during the electrolysis and would be a natural supplement to it. This was accomplished by cathodic reduction of the oxygen with iron electrodes with simultaneous supplementary absorption of the oxygen by the ferrous hydroxide formed in the process of electrolysis. This method permits complete purification of the water from oxygen. Expenditure coefficients of purification drop with an increase in temperature and with a decrease in the volumetric rate of the water in the electrolyzer. When the volumetric rate is 15-20 l. per hr. and the temperature 70-80 deg., 0.05-0.06 kv. per hr. of energy and approximately 30-40 g. of iron are required to purify 1 cu. m. of feed water from oxygen.

Digest from "Electrochemical Purification of Water from Oxygen" by A. I. Krasilshchikov and L. M. Volchkova, *Zhurnal Prikladnoi Khimii* XVII, No. 4-5, 242-251, 1944. (Published in Russia.)

DETERMINATION OF FREEZING POINT OF OIL

FREEZING point can be determined by Hennenhofer's method of extending the viscosity-temperature straight line on the basis of Ubbelohde's viscosity chart, for which purpose this chart must be made to include temperatures from -100 deg. C. and viscosities of 3×10^4 centistokes, since this viscosity can be assumed to be approximately that of the freezing point being determined experimentally. Said freezing point can therefore be found by simple determination of the viscosity of two temperatures somewhere between 20 and 100 deg. C., extending the straight line of viscosities up to the viscosity of the freezing point and reading the corresponding temperature. This theoretical freezing point agrees approximately with the one determined experimentally for oils, the viscosity of which approaches the ideal, that is to say, which flow normally at low temperatures and follow Newton's law (outlet velocity is proportional to the pressure). When the experimental and theoretical freezing points of oils show great differences, it can be assumed that such oils do not flow normally at low temperatures, do not follow Newton's law and present anomalies in their viscous structure. If this difference is more than 10 deg. C., it can be assumed that anomalies exist in the fluxion of the oil. In order to determine said freezing point graphically it is necessary to increase the size of Ubbelohde's charts so that their width is double that of the normal charts. The difficulty of using these charts is evident since the normal ones are already fairly large. This inconvenience can be avoided by using Ubbelohde's normal charts and determining the theoretical freezing point by means of a simple extrapolation with the aid of a special table. In this table a given temperature expressed in degrees C. corresponds to each value of N . The value of N is determined by the equation $N = (0.810 - W_{50})/m$, deduced from Walther's formula, in which W_{50} is the viscosity at 50 deg. C. of the lubricating oil, and 0.810 is the double logarithm of the viscosity corresponding to the freezing point. The temperature corresponding to the value of N is the freezing point (theoretical) obtained by extrapolation.

Digest from "Determination of the Freezing Point of an Oil by Extrapolation" by A. Petrikaln, *Oil u. Kohle* 40, 132, 1944, (Published in Germany).

CHEMICAL ENGINEER'S BOOKSHELF

LESTER B. POPE, Assistant Editor



Instrument panel in the Bayway refinery of the Standard Oil Co. (N. J.)

AUTOMATIC CONTROL

PRINCIPLES OF INDUSTRIAL PROCESS CONTROL. By Donald P. Eckman. John Wiley & Sons, Inc., New York. 237 pages. \$3.50

Reviewed by R. W. Porter

AUTOMATIC control has grown increasingly important to modern industry in the past three decades. During these years, advancing technology in process design and operation has come to depend more and more on modern instrumentation, and many processes used today would not be possible without precision control.

Often in the past, however, empirical methods of application have failed because they did not take into account the underlying principles of good control. The purpose of this book is to describe and explain these fundamental principles and the foundation of theory from which they are drawn. The author has described his work as an introduction to the science of automatic control, intended primarily for the college engineering student and secondarily for the industrial user of control equipment.

In treating his subject, the author analyzes control systems from the standpoint of measuring means, controller mechanism, final control element, and the process. Details of measuring devices and controlling mechanisms are brought out only when necessary to the analysis of principles and characteristics of operation, since the emphasis is on this phase of control rather than on instrument design. However, this basic information is necessarily included for complete understanding of the problems involved in process control.

Important characteristics of component parts of control systems are given and the various modes of control are explained in some detail. Different lag and capacity factors are analyzed and evaluated with respect to particular processes, and the dynamic characteristics of automatic control are stud-

ied. Considerable space is devoted to the theory, quality, and application of automatic control and various types of control systems are outlined. Methods for calculating controller settings and reaction rates are also covered.

Over 75 illustrations consisting of explanatory diagrams and curves are used to help clarify many difficult points. Throughout the book mathematical calculations and formulas are used sparingly yet adequately. A comprehensive reference list is given for each chapter to provide the reader with a source of worthwhile basic material. Perhaps one of the most useful features, for both student and experienced engineer, is the glossary of some 126 terms used in control practice.

All in all, the author has accomplished his task and has laid down a useful foundation of both theory and practice of automatic process control. The fundamental simplicity and clarity of this book should make it valuable to anyone interested in the design and operation of the process industries.

INDUSTRIAL ELECTROCHEMISTRY

ELECTRO-PLATING. Fifth edition. By Samuel Field and A. Dudley Weill. Pitman Publishing Co., New York. 483 pages. \$5.

As a reference book for electrochemists and electroplaters, Field and Weill's contribution stands well to the fore. The work is scholarly and complete but is, of course, concerned only with British practice. It covers fundamental principles of chemistry, electricity, electrochemistry and analysis of solutions always stressing the relation to plating. Discussions of materials, sources of current, solution properties, cleaning, and electroplating plants are all entirely practical. Better than half of the text is concerned with actual deposition of the various metals and alloys met in commercial plating. Under each is discussed solution, theory, addition agents, current density, anodes and cathodes,

vats, troubles, analysis of solutions and other practical and commercial considerations peculiar to the individual metal or alloy.

Difference between British and U. S. terminology and units probably preclude acceptance of the book as a text in this country. For example, batteries are "accumulators," power cost is given as "1 farthing per kwh.," gallons are imperial gallons. (Metric quantities, however, are given for various bath compositions.) Once these difficulties, if such they are, have been overcome, there remains an excellent handbook and guide for all electroplaters and chemists concerned with practical results.

FOR SUPERVISORS

TRAINING FOR SUPERVISION IN INDUSTRY. By George H. Fern. McGraw-Hill Book Co., New York. 188 pages. \$2.

Reviewed by Blaine K. McKee

ONE of the McGraw-Hill Industrial Organization and Management series, 11 books of which have already been published, "Training for Supervision in Industry" outlines a proper method for training of supervisors, but can also be used by supervisors themselves to improve their methods of handling men. Within industry the supervisor is the middleman, the man who carries out the plans of management, and to whom the workers look for fair play. For many years the author has trained supervisors, and his book is the result of his experiences.

In these postwar years, with industry moving into complicated problems of reconversion, the supervisor becomes increasingly important. His functions—management, planning and directing the work to be done, and the instruction of the men in the performance of their jobs—control the effectiveness and efficiency of his department. To achieve the best results from the workers under him, a supervisor must understand his men. This book is written primarily to train the supervisor in his relationships with the workers, to teach him to maintain a smooth-running organization through proper methods of human and job analysis so that both workers and management are satisfied.

Mr. Fern, in very elementary style, writes

RECENT BOOKS RECEIVED

Atomic Energy in War and Peace. By G. G. Hawley & S. W. Lefson. Reinhold. \$2.50.

The Heating of Steel. By M. H. Mawhinney. Reinhold. \$4.75.

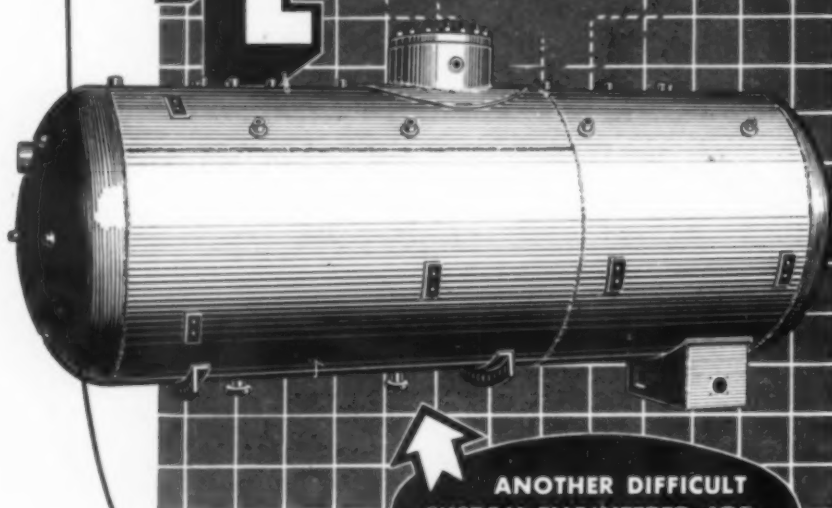
Organic Preparations. By C. Weygand. Interscience. \$6.

Raw Materials From the Sea. By E. F. Armstrong & L. M. Miall. Constructive Publications, Leicester, England. 15s.

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about the problems a supervisor encounters from the starting of a worker on a new job to the training of other supervisors by the conference method, which Mr. Fern recommends as the best method of instruction. As the author analyzes the various situations that a supervisor must face, the book becomes a psychological text, instructing the supervisor in the best methods of handling the workers to secure the greatest cooperation from them. Among others, topics of "Mental Health in Industry," "Safety and Accident Prevention," "Women in Industry," "Supervisors and Job Relations," and "How to Lead Conferences," are discussed. Through a series of tables, the author breaks down the problems of industry into their causes, results, and remedies. As the book progresses, the responsibility of the supervisor is seen as that of selecting the right person for the right job and keeping him in the right frame of mind. Mr. Fern writes in a clear, simple style, treats his subject in minute detail, and has incorporated into his book material valuable to anyone who is involved in human relationships.

ESSENCE OF AN INDUSTRY

THE SCIENCE AND ART OF PERFUMERY. By Edward Sagarin. McGraw-Hill Book Co., New York. 268 pages. \$3.

LIKE the dictionary reviewed elsewhere on these pages this month, Mr. Sagarin's book will be of direct concern to a comparatively small group of chemical engineers and chemists. From a standpoint of interest, however, practically all could read it, for it is a well-written and easily readable story of one of the more romantic fields of chemical industry. History, raw materials and uses of perfume are the principal ingredients. Also added for delicacy, bouquet and pungence are essays on the artistry of perfumery, the need for a language to describe odors, the erotic uses of the perfumer's products. There are other chapters, too, to help "round out" the finished product. They cover, among other things, industrial and commercial applications, synthesis and analysis, public preferences, and size of the industry.

"A perfume . . . must have harmony, unity and originality." Sagarin's book also has these attributes. Neither text, reference, formulary nor history, it is an introduction for the uninitiated, a compliment to the perfume chemists, and interesting reading for all.

ILLUSTRATED GLOSSARY

ELECTRONICS DICTIONARY. By Nelson M. Cooke and John Markus. McGraw-Hill Book Co., New York. 433 pages. \$5.

ALTHOUGH electronics, "that branch of science which relates to the conduction of electricity through gases or in a vacuum," is not a subject of major concern to chemical engineers, the existence of a reference book such as this should be brought to their attention. Instrument and control engineers particularly may be interested in view of the increasing usage of electronic devices for control and measurement of process variables and product quality.

The dictionary contains more than 6,400 entries. They define terms peculiar to the field, give the special electronic meanings which have become attached to various



for the production of Chemicals from Petroleum



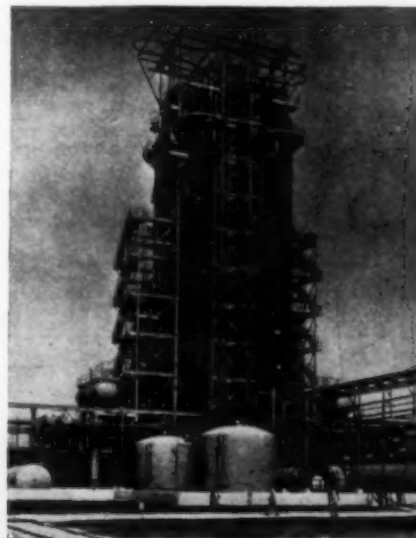
For further information on petroleum chemicals, send for a copy of the latest edition of "Petroleum Refining Processes;" 56 pages of data, flow sheets and photographs.

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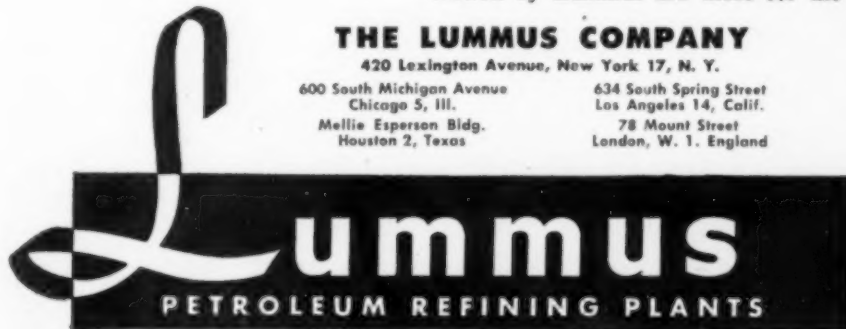
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Veterans Statutory Reemployment Rights. Selective Service System. Price 10 cents.

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Notes on Practical Water Analysis. By W. D. Collins. Geological Survey Water-Supply Paper 596-H. Price 10 cents.

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The Painting of Exterior Wood Surfaces. Bureau of Standards Letter Circular LC810. Mimeographed.

The Aluminum Industry. Report of the Attorney General to Congress. Senate Document No. 94. Price 15 cents.

Reference Manual of Government Corporations. General Accounting Office Report to Congress. Senate Document No. 86. Price \$1.

Study of the "H" Test for Evaluating the Adhesive Properties of Tired Cord in Natural

and GR-S Rubbers. By W. James Lyons, Mary L. Nelson, and Carl M. Courad. Bureau of Agricultural and Industrial Chemistry. AIC-99. Mimeographed.

A Selected and Annotated Bibliography on Soft Corn and Pertinent Information on the Drying, Preservation, and Storage Behavior of Corn and Other Grains. By Carol M. Jaeger, J. H. Shollenberger, and M. M. MacMasters. Bureau of Agricultural and Industrial Chemistry. AIC-100. Mimeographed.

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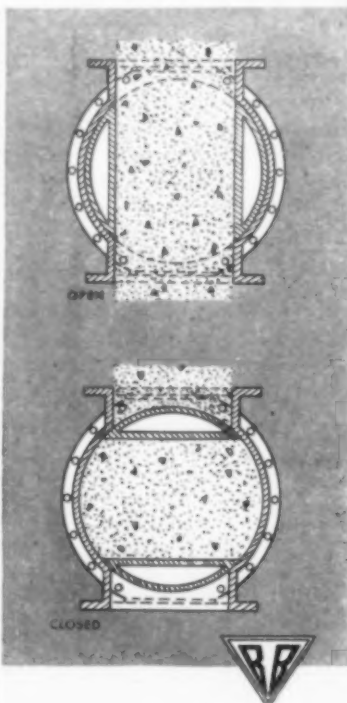
Size of Smallest Dust Particles Revealed by Various Microscopic Systems. By Carlton E. Brown and Florence L. Feicht. Bureau of Mines. Report of Investigations R. I. 3821. Mimeographed.

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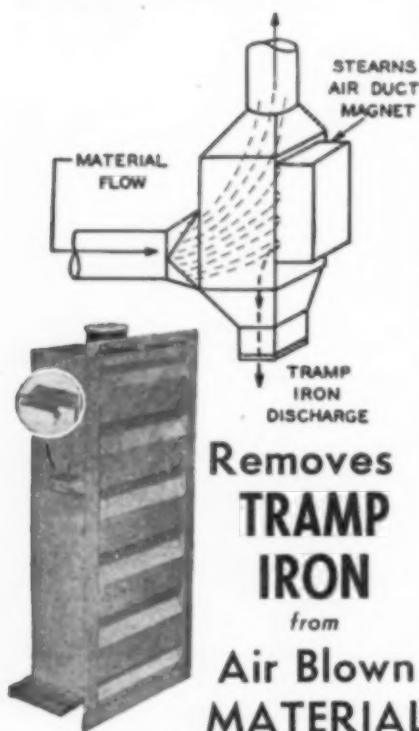
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man. Bureau of Mines, Report of Investigations R. I. 3831. Mimeographed.

Mineral Trade Notes. Bureau of Mines. A revised monthly inventory of information from U. S. Government Foreign Service Offices and other sources that may not otherwise be made available promptly. Available without charge through bureau mailing list on request.

Alcohol Statistics. Bureau of Internal Revenue. Alcohol Tax Unit has now summarized and released data on the production of alcohol and specially denatured products during recent fiscal years, through the year ending June 30, 1944. Requests for data should be very specific, as no single comprehensive publication has yet been issued.

Handbook of Job Descriptions. War Manpower Commission leaflets. Descriptions of jobs in specialized fields and the types of work done by men holding those jobs have been prepared as "handbooks" by the National Roster. There is one of these leaflets for each type of technical employment, including each of the sciences and each of the divisions of engineering. Requests for single copies should be addressed to National Roster of Scientific and Specialized Personnel, Washington 25, D. C.

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RECENT BOOKS and PAMPHLETS

Plastics, the Story of an Industry. Prepared by Society of the Plastics Industry, 295 Madison Ave., New York 17. 36 pages. Authentic information for the public about plastics.

Record of Inventions—Conception Dates. By R. T. K. Cornwell, Director of Research,sylvania Industrial Corp., Fredericksburg, Va. A legal-size pad of forms on which ideas may be recorded. Spaces are provided for signatures, dates, etc.

Quis on Railroads and Railroad. Fourth edition. Published by Association of American Railroads, Transportation Building, Washington 6, D. C. 80 pages. Gratis. Answers to many questions frequently asked about American railroads, their history, properties, operations, and the like.

Newsletter. Issued occasionally by The Twentieth Century Fund, New York 18, N. Y. Vol. I, No. 1 of a new newsletter of Fund activities.

Practical Design of Welded Steel Structures. By H. M. Priest. Published by American Welding Society, 33 W. 39th St., New York 18, N. Y. 150 pages. Price \$1. For designers, engineers and fabricators who use welded construction.

Manual of Procedure Under Government Contracts. Fourth edition. By O. R. McGuire. Published by Fidelity and Deposit Co. of Maryland, Baltimore. 86 pages. Gratis. Valuable information for firms interested in, or now supplying, goods or services to the federal government.

A.S.T.M. Standards on Petroleum Products and Lubricants. Published by American Society for Testing Materials, 260 S. Broad St., Philadelphia 2, Pa. 546 pages. Price \$2.75. Annual edition of methods of testing, specifications, definitions, and charts and tables.

Handbook of Industrial Radiology. Edited by J. A. Crowther. Published by Edward Arnold & Co., London. 203 pages. Nine lectures giving principles, design requirements, protection, etc.

The Heating of Steel. By M. H. Mawhinney. Published by Reinhold Publishing Corp., New York 18, N. Y. 265 pages. Price \$4.75. Chemical effects of heating steel; fuels; burner equipment; temperature distribution; furnace control; heat transfer; quenching; alloys; refractories; furnaces.

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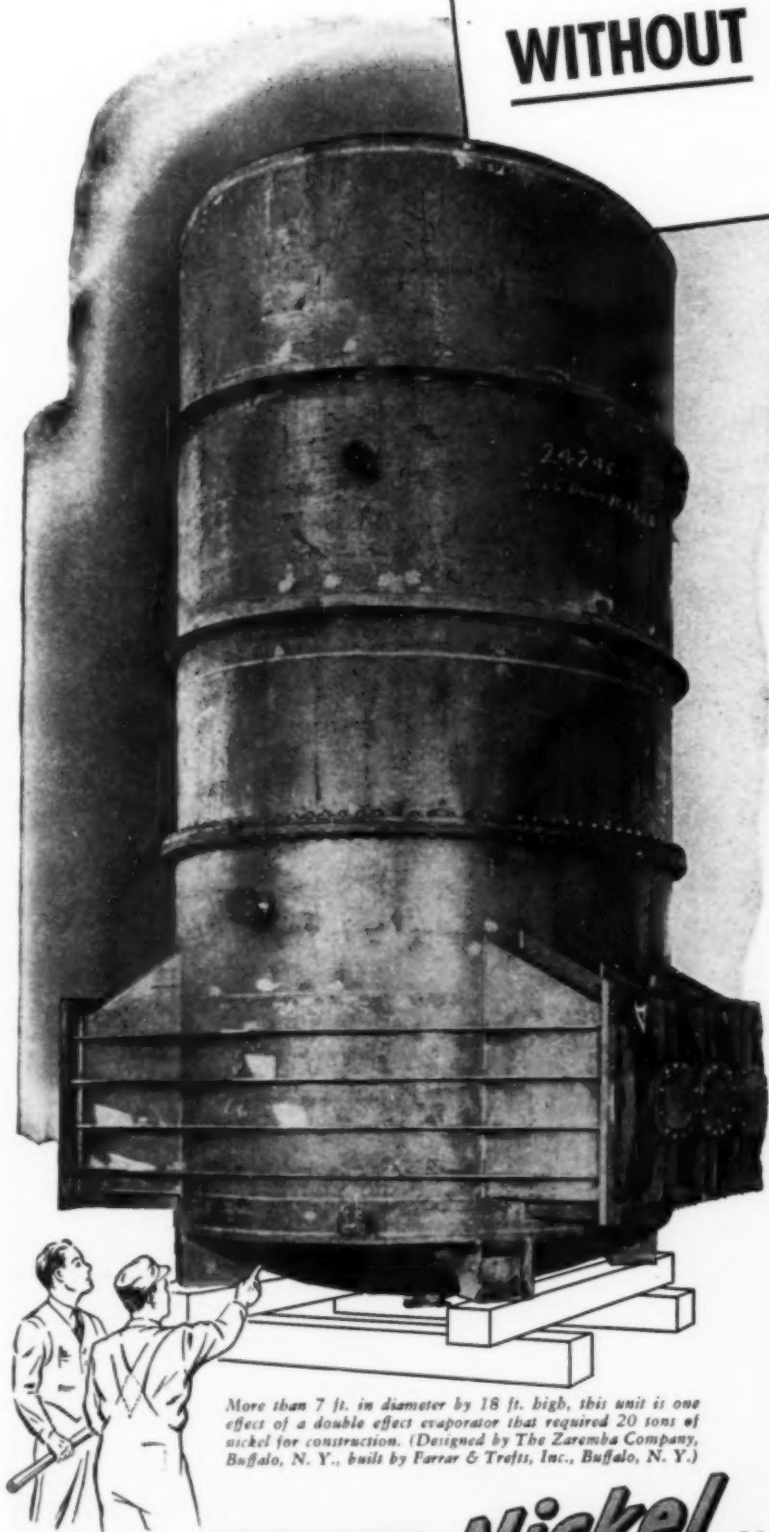
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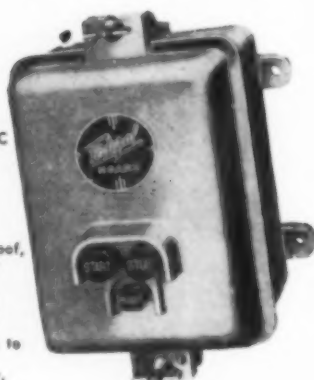
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Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterheads.

Ammonia Dissociator. Drever Co., 748 E. Venango Street, Philadelphia 34, Pa.—Bulletin B-51. 12-page booklet featuring the ammonia dissociator and other ammonia equipment built by this company. Tables of sizes and capacities are given and application diagrams are shown.

Beryllium Compounds. Clifton Products, Inc., Painesville, Ohio—12-page booklet describing the beryllium chemicals available from this company. Specifications, properties, uses, shipping methods and price lists are given for such items as beryllium oxide, refractory grade; beryllium hydroxide; beryllium sulphate; beryllium stearate.

Crushers. Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.—Bulletin B-6004-A describes the Superior-Metulley gyratory crushers manufactured by this company.

Deaerators. Elliott Co., Jeannette, Pa.—Bulletin N-15. 20 page booklet illustrating deaerators and feed water heaters built by this company. The need for deaeration of feedwater to combat corrosion is explained in principle and illustrated by diagrams and curves.

Dryer. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin B-6378 describes and illustrates typical installations and uses for rotary dryers and coolers. Contains specifications, capacities and dimension tables, as well as recommendation of the types of equipment for various services.

Dust Collectors. Claude B. Schneible Co., 2827-25th St., Detroit 16, Mich.—Bulletin No. 310. Twenty-page booklet illustrating and describing the multi-wash wet method of dust collection equipment manufactured by this company. Features of this equipment are shown for collectors, settling and dewatering equipment, pumps, and separators. A large number of applications of this equipment are illustrated.

Electric Motors. Crocker-Wheeler Electric, Div. Joshua Hendy Iron Works, Ampere, N. J.—4-

page leaflet illustrating and describing the Sealed-power motor for general-purpose applications where there is excessive moisture and where the atmosphere contains large quantities of dust. Several types of applications are described.

Electric Motors. Star Electric Motor Co., 210 Bloomfield Ave., Bloomfield, N. J.—8-page illustrated catalog featuring typical applications for the electric motors built by this company. Specifications and ratings of the various types of motors are included.

Elevating Tables. Lyon-Raymond Corp., Greene, N. Y.—Bulletin 141. 8-page folder featuring the portable hydraulic elevating tables manufactured by this company. Features and specifications are shown.

Fire Extinguishers. American-LaFrance-Foamite Corp., Elmira, N. Y.—A new series of concise, comprehensive instruction charts, explaining the operation and maintenance of four of the most widely used types of hand fire extinguishers is now available from this company. Illustrations show the various steps in handling, operating and maintaining the extinguishers.

Floor Protection. L. Sonneborn Sons, Inc., 88 Lexington Ave., New York, N. Y.—4-page illustrated leaflet describing Lapidolith liquid which wear-proofs and dust-proofs concrete floors and other concrete surfaces. This material protects floors against disintegration resulting from concrete dust, acids, salts, alkalis and many other substances.

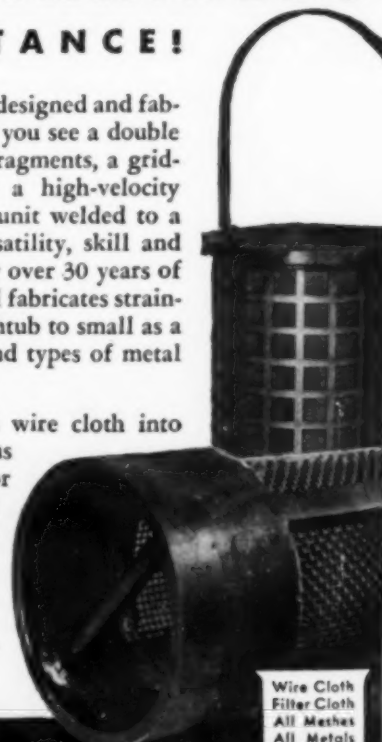
Forest Products. American Forest Products Industries, Inc., 1319 - 18th St., N.W., Washington 6, D. C.—142-page guide booklet designed to aid coordination of forest products research. This book lists a number of institutions, producers, consumers and processors of porous products, together with the technical societies and private laboratories involved in this work. Various chapters deal with the structure and properties

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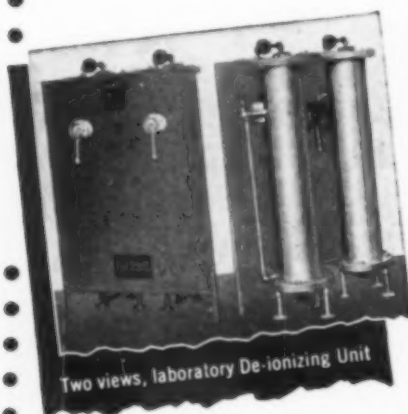
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Laboratory Ware. Norton Co., Worcester, Mass.—12-page booklet featuring Alundum laboratory ware made by this company.

Materials Handling. Mixermobile Co., Inc., 608 South Hill Street, Los Angeles 14, Calif.—4-page leaflet featuring the Scoopmobile, a loading and lifting truck for handling bulk or packaged material.

Materials Handling. Speedways Conveyors, Inc., 3080 Main St., Buffalo 14, N. Y.—Four-page folder describing the lightweight gravity case conveyors made by this company.

Molding Plastics. Chemaco Corp., Berkeley Heights, N. J.—22-page brochure featuring the various plastic molding materials available from this company. Properties and specifications for the various materials are given together with suggested applications. A section is devoted to molding methods by various processes.

Pallets. General Box Co., Chicago, Ill.—Illustrated booklet featuring the Generalift pallets made by this company. Information on the use of pallets in industry is given.

Petroleum Refining. M. W. Kellogg Co., 25 Broadway, New York 7, N. Y.—Loose-leaf folder describing the Kellogg engineering organization and its function in the development, design and construction of post-war refining facilities. Several complete economic studies for refineries in different areas in the United States are given.

Plastics. Tennessee-Eastman Corp., 10 East 40th St., New York 16, N. Y.—12-page booklet discussing the forming of articles from extruded sheeting. The various operations involved are described and illustrated.

Pumps. American Marsh Pump, Inc., Battle Creek, Mich.—Bulletin 381. 6-page bulletin illustrating and describing the important features of the two-stage centrifugal pumps built by this company. Specifications, sizes and dimensions are given.

Pumps. Kinney Manufacturing Co., Washington Street, Boston.—Bulletin C-45. 24-page bulletin featuring the high vacuum pumps made by this company. Features of this pump are illustrated and described and information is given on the selection of vacuum pumps for different applications. Formulas and tables are given to help in determining the correct pump size for different uses.

Pumps. Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin H-450-B33. 12-page booklet features typical applications of this company's vertical turbine pumps.

Refrigeration. Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin C-1100-B14. 24-page booklet illustrates and describes the centrifugal refrigeration system used in a wide variety of applications. Sizes and specifications of equipment are included and design features for the various pieces of equipment such as condensers, evaporator instrument and controls are given. Operating characteristics are shown by graphs and tables.

Research. Arthur D. Little, Inc., Cambridge, 42, Mass.—24-page brochure describes the history and function of this company in industrial research.

Rubber Equipment. B. F. Goodrich Co., Akron, Ohio—12-page guide book for industrial designers featuring the use of Koroseal and other rubber materials manufactured by this company. Physical and chemical properties of Koroseal are given and a number of applications suggested. Contains information on molded parts, lathe-cut products, extrusions, vibration insulators, rubber-lined equipment, etc.

Safety Valves. Ferris Engineering Co., 400 Commercial Ave., Palisades Park, N. J.—Bulletin No. 45-A. The complete line of safety and relief valves manufactured by this company are illustrated by a ready-reference pictorial index chart showing line drawings of the basic valve types.

Separators. Flotrol Systems, Inc., 385 Gerard Ave., New York 31, N. Y.—8-page illustrated booklet describing the Lewis Excel-So water separator and filter for removing water and dirt from petroleum products in gasoline plants, pipe lines and refineries. Features of this equipment are described and application diagrams are shown for different uses. Cross-sectional diagrams illus-

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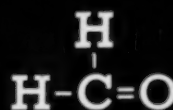
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trate the principles of operation and show dimensions of the various models.

Silicate Cement. Nukem Products Corp., Buffalo 20, N. Y.—4-page leaflet describing the silicate cement manufactured by this company. Includes physical properties, instructions for use, table of applications, and properties of this material.

Silicone. Dow-Corning Corp., Box 592, Midland, Mich.—12-page reprint discussing silicone varnishes for insulating electrical equipment. Contains an informative account of silicone engineering and describes the various test data on the effectiveness of this material as electrical insulation.

Spray Nozzles. Yarnall-Waring Co., Chestnut Hill, Philadelphia 18, Pa.—Bulletin N-616. 16-page booklet describing this company's spray nozzle for water-cooling, air-conditioning and for general industrial uses. Features of the spray nozzles and accessory equipment are shown, and some of the applications are described. Contains capacity charts, together with tables of dimensions and sizes of the various types of nozzles.

Stainless Steel. Republic Steel Corp., Cleveland 1, Ohio—Bulletin No. 430. 32-page booklet illustrating the many uses of Enduro stainless and heat-resisting steels in wartime applications.

Steam Generator. C. H. Dutton Co., Kalamazoo, Mich.—Booklet describes the Econotherm steam generator which is a completely self-contained fully automatic steam generating unit. Features of this unit are illustrated for 150 hp, oil or gas-fired boilers.

Sulphur Dioxide. Ansul Chemical Co., Marinette, Wis.—Bulletin 441.3. 4-page leaflet describing a method for continuously preparing sulphur dioxide solutions. This method is described in detail and illustrated by diagrams. Also 12-page leaflet consisting of a reprint on the application and use of liquid sulphur dioxide.

Textile Resins. American Cyanamid Co., Bound Brook, N. J.—Bulletin No. 109 describes the properties and uses of Aerotex resin M-3 in textile finishing. Bulletin No. 108 describes the uses of Aerotex resin 7513 used in textile finishing.

Titration. Wilkens Anderson & Co., 111 N. Canal Street, Chicago, Ill.—4-page leaflet describing the dead stop end point titration for moisture determination and for measurement of organic compounds through oxidation reduction titrations.

Valves. Jenkins Bros., 80 White St., New York 15, N. Y.—This company now has available a check system in the form of a file folder and record sheet for use in setting up a repair and maintenance schedules for valves.

Valves. Everlasting Valve Co., 49 Fisk St., Jersey City 5, N. J.—Bulletin E-150. 14-page brochure features the lever-operated gate valves manufactured by this company. Types of valves with their typical services are shown. Includes tables of sizes, dimensions, weights and list prices for the various valves offered.

Valves. Reading, Pratt & Cady Div. American Chain & Cable Co., Inc., Bridgeport 2, Conn.—Valve chart giving pictures and data on brass valves with vital parts that can be renewed. Contains information on how to renew and replace worn-out parts as well as giving ordering information.

Water Treatment. W. H. & L. D. Betz, Gillingham and Worth Sts., Philadelphia 24, Pa.—18-page reprint entitled Once Through and Recirculating Cooling Water Studies, discusses the results obtained in scale prevention in cooling water systems using various chemicals under various conditions. Technical Paper No. 102.

Welding. Air Reduction Sales Co., Inc., 60 East 42nd Street, New York 17, N. Y.—16-page booklet featuring the Wilson Bumblebee alternating current transformer arc welding machine available from this company. Engineering data and complete specifications are given and important features of this machine are illustrated. Also Catalog No. 130. 12-page catalog of arc welding accessories furnished by this company.

Welding. Ampeco Metals, Inc., 1745 South 38th St., Milwaukee 4, Wis.—Bulletin WH. 10-page industrial application chart showing in chart form many of the applications of aluminum electrodes in various industries.

Welding. Wilson Welder & Metals Co., Inc., 60 East 42nd St., New York 17, N. Y.—32-page illustrated catalog designed to guide electrode users in the selection of the right electrodes for any specific job. Complete data are given on electrodes for many types of work on a wide variety of base metals.

Wire Rope Clamps. National Production Co., 4550 St. Jean Ave., Detroit 15, Mich.—12-page leaflet featuring the Safe-Line wire rope clamps manufactured by this company.

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CHEMICAL ECONOMICS

H. M. BATTERS, Market Editor

INDUSTRIAL CONSUMPTION OF CHEMICALS AT NEW HIGH IN FINAL QUARTER OF LAST YEAR

WHILE total production of chemicals has dropped from the wartime peak, the decline reported for industrial chemicals by the Federal Reserve Board has not been as large as might have been expected in view of the elimination of different heavy consuming outlets. Production of industrial chemicals reached its peak in June 1945 as measured by the board's index which stood at 412 for that month. A moderate break in July was followed by a sharp drop in August when the index number was reported at 368. The revised number for October is 377—the preliminary figure was 367—and the preliminary standing for November is 386. Hence the November rate of production was but little more than 6 percent below the all-time high.

The Federal Reserve index for all industrial production reached its high point of 249 in October 1943. The low of 165 was reported for October 1945 with an indicated recovery to 171 in November. The November position represents a drop of more than 31 percent from the record level of October 1943 but while these indexes normally show the status of industrial production, a part of such production during the war referred to goods essential to the war effort. However, this does not minimize the excellent showing made by chemicals in comparison with that reported for all industry.

While complete data for December are not yet available, the Chem. & Met. index for consumption of chemicals is 194.94 for October and 190.49 for November and the figures at hand for December make it certain that the final quarter of last year marked a new high in industrial use of chemicals. This was made possible by the fact that some industries, notably fertilizer and rayon, operated at rates even higher than their wartime peaks. Furthermore, larger parts of rubber and plastics production were for civilian account.

All consuming industries, however, did not move in the same direction. In some cases, conditions within the industry were not favorable. Textile manufacturers find a ready market for all the finished products they can turn out. There are no shortages of cotton or other important fibers but textile plants have long suffered from a scarcity of skilled workers. It had been expected that returning veterans and the release of workers from higher-paid war jobs would solve the labor problem of the textile mills but such has not been the case and many of the mills have been forced to shorten their working week.

The over-all labor situation likewise has lowered the potential in many lines of industry. For instance, some months ago it

was estimated that close to 500,000 automobiles would be turned out in 1945. This estimate could be translated into terms of chemical requirements for such an output. The outcome was so far below the estimate that the full potential for chemicals was not even approached. Work stoppages in some lines further cut down the potential. This may be exemplified in the case of plate glass where monthly production fell below 500,000 sq. ft. as a result of strikes at leading producing plants. In summary this means that demand for chemicals was not cut down materially when the war ceased to be a factor. The loss in military buying was greatly offset by the necessity to operate most plants at full speed in order to fill civilian requirements but other factors prevented the maximum attainment.

Oil refining which slowed up with the curtailment in use of fuel oil and high octane gasoline, again went on a rising curve in the latter part of the year. The Bureau

of Mines has upped its estimates for requirements for the early part of this year and looks for a need of 4,500,000 bbl. per day to fill January demands. The sharp drop in refining in September and October brought a shortage in some refined products and caused an increase in operations in November and December although the rate still is much below that maintained earlier last year.

The Survey of Current Business says the current situation differs among the producers goods, consumers durable goods and consumers nondurable goods industries. In the first group, including among others, machinery and equipment, the dominant factor has been the drop in government procurement. This has brought a reduction in output to considerably less than half of the average of the final months of the war. A similar sharp reduction occurred in the consumers durable goods industries which were contributing heavily to the flow of munitions and other implements of war.

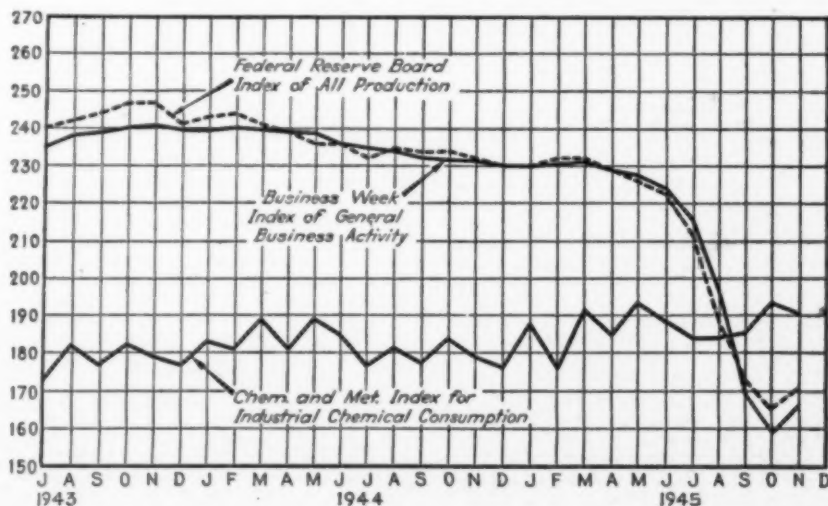
In the nondurable goods industries, the decline with the war's end was not very large and was wiped out in the over-all average by October. Here there was considerable shifting of the final destination of the products as deliveries to the government went down and those to civilian trade channels went up. This summary offers a good explanation for the rise in the Chem. & Met. index for consumption of chemicals at a time when general production was on the decline.

The supply of drying oils fails to show much improvement although the home supply of flaxseed favors some expansion in production of linseed oil. Stocks in October continued to decline and the same was true for tung and hydrated castor oils. The crush of cottonseed shows a seasonal gain but none of the refined oils are too plentiful in the current market.

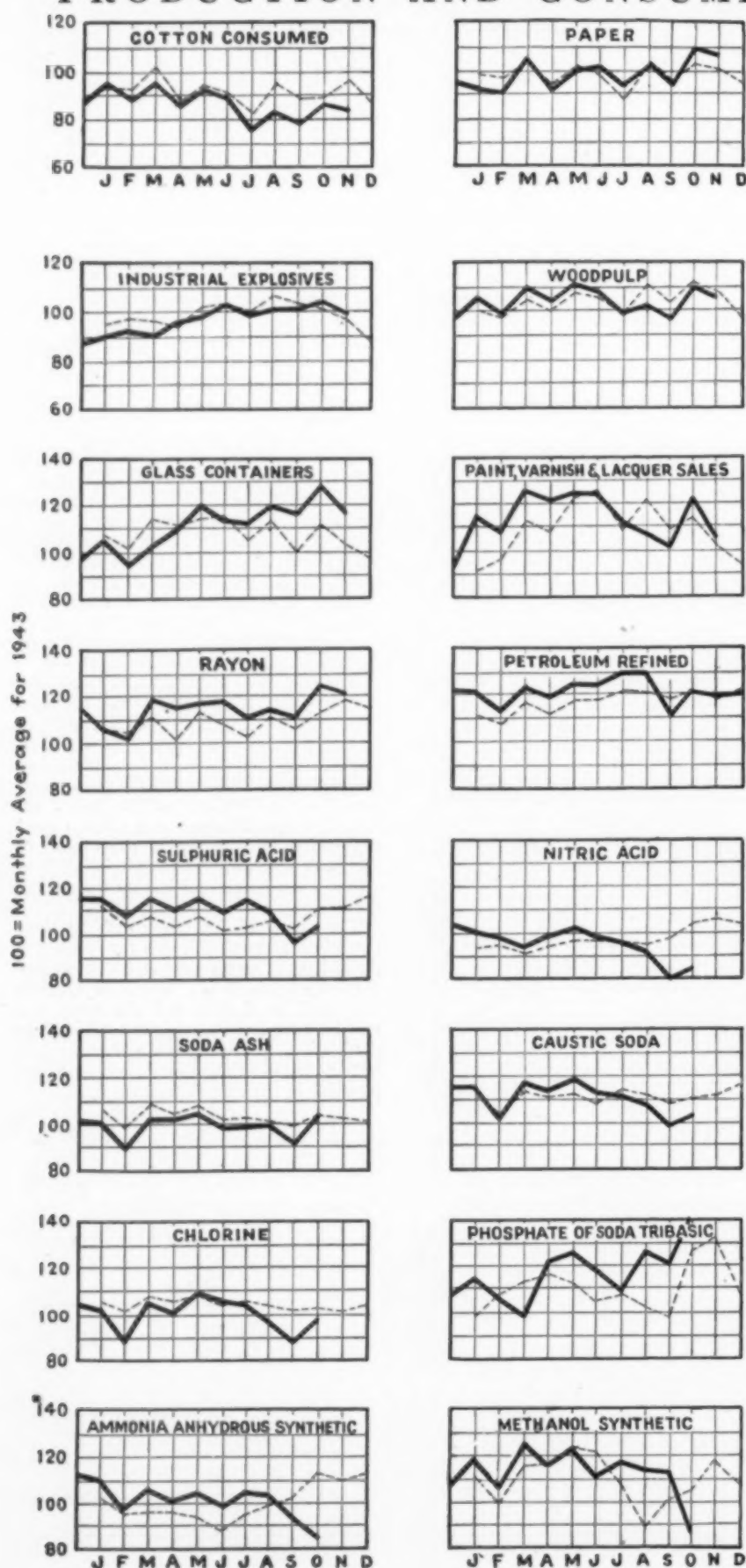
Chem. & Met. Index for Industrial Consumption of Chemicals

1935 = 100

	Oct. revised	Nov.
Fertilizers	46.05	45.15
Pulp and paper	21.20	20.10
Petroleum refining	17.16	18.47
Glass	21.60	19.62
Paint and varnish	18.05	16.32
Iron and steel	10.15	10.96
Rayon	19.72	19.05
Textiles	10.40	10.19
Coal products	7.35	7.95
Leather	4.40	4.45
Industrial explosives	5.66	5.48
Rubber	7.20	6.90
Plastics	6.00	5.85
	194.94	190.49



PRODUCTION AND CONSUMPTION TRENDS



WHILE REPORTS from industry have been mixed in recent weeks, the unfavorable news has come largely from producers whose outputs have been hampered by work stoppages, shortage of manpower, or for other reasons which should find early solution. Where more favorable conditions prevailed, the trend of production has been upward with no change in the basic conditions which prompted earlier prognostications that with productive capacities expanded, with a huge backlog of consumer requirements, with export possibilities greatly enhanced, and with a purchasing power swollen by wartime prosperity, business would head toward a point but little below wartime levels and far above that of any prewar era.

Many untoward factors, with labor difficulties among the foremost, have had their effect yet confidence in the outlook has not been shaken and for that we have the words of many industrial leaders who have given stimulating views on the prospects for their respective industries for the coming year.

Prospects for the lines which were furthest removed from war influences have been generally conceded as bright but some doubt has been expressed concerning the future of some lines of manufacture which became inflated because of direct war contacts. Production of ammunition, ships, tanks, guns, and planes has taken the inevitable drop but some other lines which were tied up rather closely with the war program, while falling from their peak levels, have continued to make an excellent showing and give promise of renewing an upward trend.

Oil refiners were forced to expand outputs in order to meet war requirements. Around the middle of last year a reappraisal of requirements for the armed forces was made and while a cut in production of aviation gasoline resulted, demand for other petroleum products was large enough to keep refining operations at record levels. However, in August and September, cut-backs became more general but they were followed by a recovery in the latter part of the year. While 1941 is referred to as the last prewar year, wartime influences were at work in the greater part of that year and oil refining had moved up considerably above the then normal. It is probable that 1946 will record a fair advance over 1941 in the production and movement of petroleum products. If this proves to be correct, there will not be too big a drop from wartime levels.

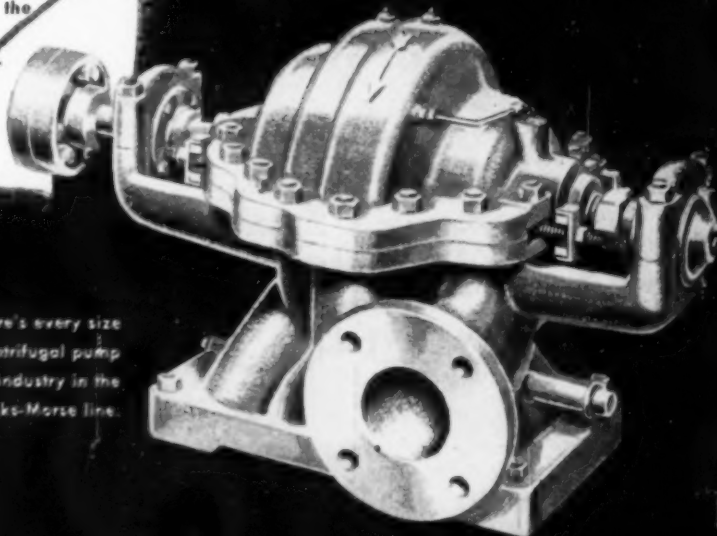
What will happen to the new synthetic rubber industry also has been a big question mark. The answer to its ultimate position will not be found in the immediate future. Surveys have brought out that natural rubber can be produced in quantities far in excess of world requirements but the condition of many plantations, scarcity of labor, and other factors will make it impossible for natural rubber to take care of more than a part of total requirements in the present year. The domestic synthetic rubber industry is expected to turn out at least 600,000 tons in 1946. Beyond that it is difficult to foresee. If natural rubber became immediately available, it would be given the preference but the time element may make

Can ANYONE make a Pump?

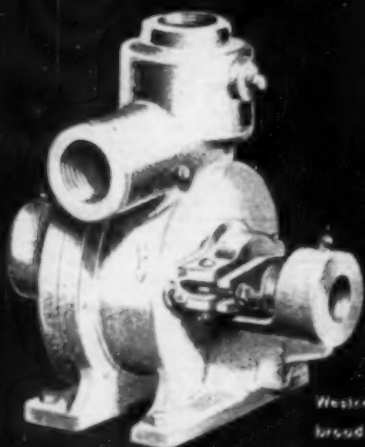
Well, there's no law against it—except perhaps the "law of survival." It's a question of what kind of pump you want—and how good you want it to be.

If you want a pump that will squeeze the last fraction of a cent in value out of the monthly power bill, that is designed to the very limits of hydraulic knowledge—built with the fine tools and complete facilities that such precision design requires—you'll want a Fairbanks-Morse pump.

There's every size and type of centrifugal pump used in industry in the Fairbanks-Morse line.



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it possible for the synthetic product to be improved to a point where it may parallel the history of silk and rayon.

The fertilizer industry is such a large consumer of chemicals that any material change in its position is immediately reflected in the movement of chemicals. The use of fertilizer chemicals has grown enormously in the last four years. A good part of this growth must be maintained or some of

our increased sulphuric acid capacity will be forced to find new outlets. To date, fertilizer manufacture has continued on an upward curve and world demand for food-stuffs is sufficient to warrant a continuance of the trend. However, the current rate of production is so much above prewar levels that some decline may set in later but for the current fertilizer year a new record is in sight, especially for superphosphate.

United States Production of Certain Synthetic Organic Chemicals

September 1945, September 1944 and Nine-Month Totals for 1945 and 1944

Item	September 1945	September 1944	Total, First 9 Months 1945	Total, First 9 Months 1944
Acetanilide, technical and USP.....	820,900	---	4,126,628*	3,077,993*
Acetic acid, synthetic ¹	18,373,451	22,277,754	201,900,516	216,943,844
Acetic acid, natural ²	2,438,893	3,053,550	25,815,871	29,988,081
Acetic anhydride ³	37,789,450	40,837,920	397,185,438	365,343,708
Acetylsalicylic acid, aspirin.....	961,996	786,429	7,972,955	6,802,885
n-Butyl acetate.....	4,009,395	4,768,894	50,675,518	53,872,213
Cresote oil, tar distillers ⁴	9,800,002	6,933,432	96,293,041	89,863,424
Cresote oil, byproduct ^{5,6}	2,398,293	4,121,993	26,988,502	30,912,512
Cresols, meta-para ⁷	937,129	641,437	6,354,255	5,214,789
Cresols, ortho-meta-para ⁷	866,487	999,005	7,064,931†	7,660,527
Cresylic acid, crude.....	2,147,513	2,018,219	20,224,569	19,103,268
Cresylic acid, refined ⁸	2,430,999	3,368,852	22,410,430	39,945,510
Diethyl ether.....	4,487,628	5,984,137	44,919,732	46,377,683
Ethyl acetate.....	6,849,233	7,767,068	82,316,819	78,381,140
Lactic acid, edible.....	---	3,769,917	382,754	2,679,022†
Lactic acid, technical.....	---	182,336	3,042,907	2,008,581
Methyl chloride, all grades.....	2,251,734	2,417,784	22,257,406	17,272,338
Naphthalene, coke-oven operators ^{9,10}	7,632,973	8,685,427	87,910,067	78,051,410
Naphthalene, tar distillers ^{9,10}	20,252,928	17,023,980	155,586,622	147,847,085
Naphthalene, refined ¹⁰	7,772,986	5,979,455	54,865,382	63,630,097
Oxalic acid, technical.....	1,521,577	1,590,158	15,081,902	13,240,293
Phenobarbital and sodium salts.....	22,989	11,302	208,280	170,263
Phthalic anhydride.....	9,567,194	10,611,285	98,810,416	92,066,879
Sulfa drugs, total ¹¹	462,333	182,328	4,342,695	3,517,566

All data in pounds except cresote oil (gal.) Statistics collected and compiled by U. S. Tariff Commission except where noted. ¹ Excludes statistics on recovered acid which are confidential. ² Acid produced by direct process from wood and from calcium acetate. ³ All acetic anhydride including that from acetic acid by vapor-phase process. ⁴ Product of distillers who use purchased coal tar only. ⁵ Product of byproduct coke-oven operators only. ⁶ Statistics collected and compiled by Bureau of Mines. ⁷ Total production including data reported both by coke-oven operators and by distillers of purchased coal tar. ⁸ Statistics combine three grades: solidifying at less than 74 deg. C.; 74 to less than 76; 76 to less than 78. ⁹ Statistics represent production for sale only for less than 74 grade; for other two grades they represent for sale and for consumption within producing plant. ¹⁰ 79 deg. C. and over. ¹¹ Includes data for acetylsulfathiazole, both as drug and intermediate, resulting in appreciable unavoidable duplication. * Seven-month total, figures for two months were confidential. † Eight-month total.

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The tower of a Schneible Multi-Wash Collector is ruggedly built of steel plate—or other metal for special requirements. All interior parts are adequately protected against abrasion by cyclonic sprays of water, which act as an abrasion cushion. Ready accessibility for interior painting or removal of the impingement trays make maintenance simple. Consequently when Schneible dust control equipment finally requires a maintenance check-up, it is an easy, economical job to do.

This is a prime reason why so many Schneible dust and fume collection systems have been installed in process plants all over the nation.



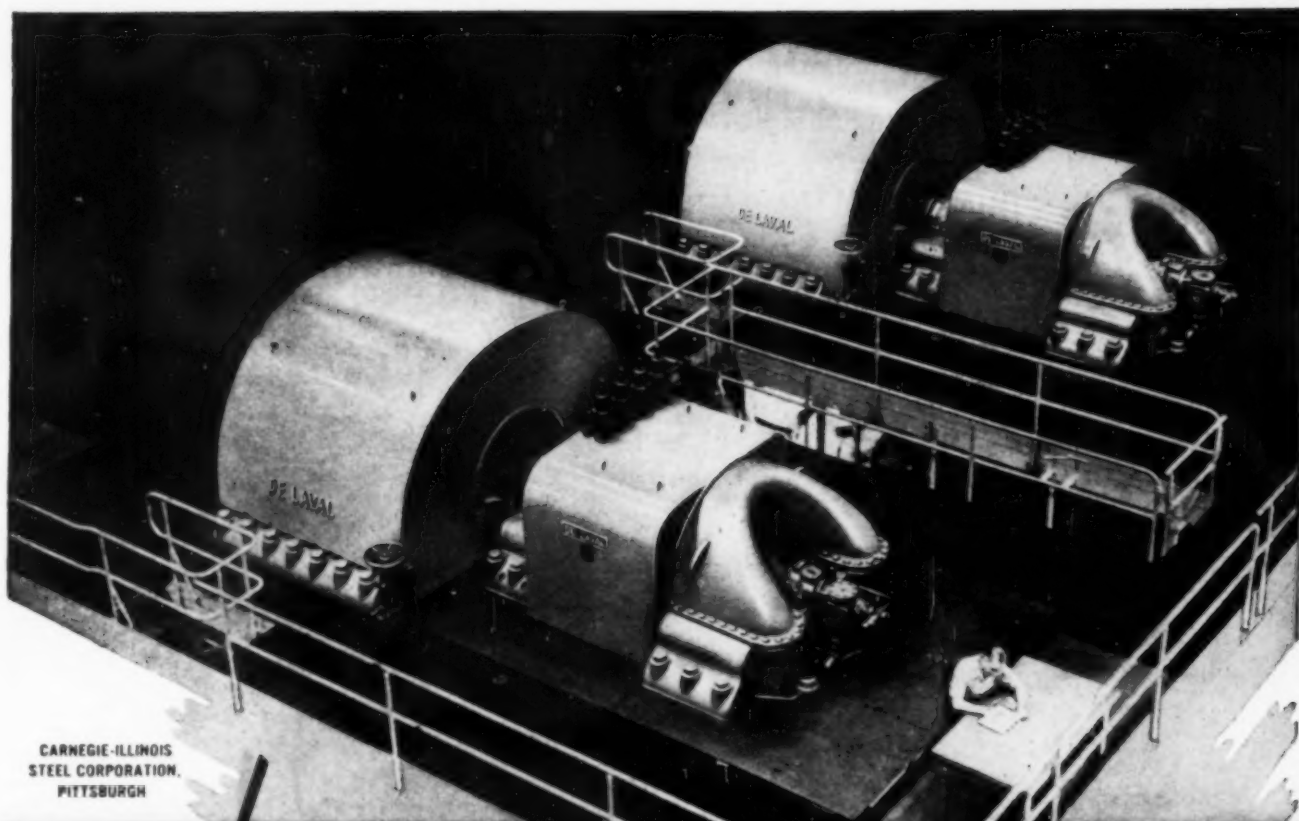
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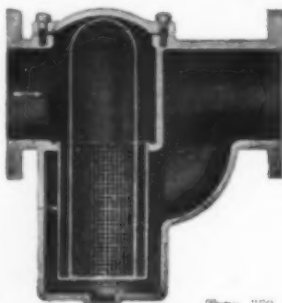
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Men under 30 years of age preferred for both positions. Please fully state in first letter training, education and experience so that interviews can be arranged. All applications will be acknowledged.

Caterpillar Tractor Co.

Peoria, Illinois

CHEM. & MET.

Weighted Index of Prices for CHEMICALS

Base = 100 for 1937

This month	109.13
Last month	109.08
January, 1945	108.81
January, 1944	109.54

CURRENT PRICES

The accompanying prices refer to round lots. Where it is trade custom to sell f.o.b. works, quotations are so designated. Prices are corrected to January 11

INDUSTRIAL CHEMICALS

Acetone, tanks, lb.	\$0.06
Acid, acetic, 28%, bbl., 100 lb.	3.38 - \$3.63
Boric, bbl., ton	109.00 - 113.00
Citric, kegs, lb.	.20 - .23
Formic, cbva., lb.	.104 - .11
Hydrofluoric, 30%, drums, lb.	.08 - .085
Lactic, 44%, tech., light, bbl., lb.	.073 - .075
Muriatic, 18%, tanks, 100 lb.	1.05 - .
Nitric, 36%, carbons, lb.	.05 - .054
Oleum, tanks, wks., ton	18.50 - 20.00
Oxalic, crystals, bbl., lb.	.114 - .124
Phosphoric tech., tanks, lb.	.04 - .
Sulphuric, 60%, tanks, ton	13.00 - .
Tartaric, powd., bbl., lb.	.704 - .
Alcohol, amyl	.131 - .
From pentane, tanks, lb.	.101 - .184
Alcohol, butyl, tanks, lb.	.542 - .
Alcohol, ethyl, denatured, 190 proof	.041 - .
No. 1 special, tanks, gal.	1.15 - 1.49
Alum, ammonia, lump, lb.	.141 - .
Aluminum sulphate, com, bags 100 lb.	59.00 - 69.00
Ammonia, anhydrous, cyl., lb.	.094 - .10
Ammonium carbonate, powd., casks, lb.	28.20 - .
Sulphate, wks., ton	.145 - .
Amyl acetate, tech. from pentane, tanks, lb.	.024 - .03
Aqua ammonia, 26%, drums, lb.	.65.00 - .
tanks, ton	.04 - .044
Arsenic, white, powd., bbl., lb.	.65.00 - 75.00
Barium carbonate, bbl., ton	75.00 - 78.00
Chloride, bbl., ton	.094 - .11
Nitrate, casks, lb.	60.00 - 70.00
Blanc fix, dry, bags, ton	2.50 - 3.00
Bleaching powder, f.o.b., wks., drums, 100 lb.	45.00 - .
Borax, gran., bags, 100 lb.	3.00 - .074
Calcium acetate, bags, 100 lb.	50.00 - .
Arsenic, dr., lb.	18.50 - 25.00
Carbide, drums, ton	.05 - .054
Chloride, flake, bags, del. ton	.73 - .80
Carbon bisulphide, drums, lb.	1.75 - 2.00
Tetrachloride, drums, gal.	17.00 - 18.00
Chlorine, liquid, tanks, wks., 100 lb.	.194 - .20
Copperas, bags, f.o.b., wks., ton	5.00 - 5.50
Copper carbonate, bbl., lb.	.50 - .57
Sulphate, bbl., 100 lb.	.141 - .154
Cream of tartar, bbl., lb.	1.80 - 2.00
Diethylene glycol, dr., lb.	.107 - .
Epsom salt, dom., tech., bbl., 100 lb.	.032 - .
Ethyl acetate, tanks, lb.	.094 - .
Formaldehyde, 40%, tanks, lb.	1.05 - 1.108
Furfural, tanks, lb.	.184 - .19
Glauber's salt, bags, 100 lb.	.084 - .
Glycerine, c.p., drums, extra, lb.	.094 - .
Lead:	.12 - .13
White, basic carbonate, dry, casks, lb.	.11 - .12
Red, dry, sek., lb.	.044 - .044
Lead acetate, white crys., bbl., lb.	.074 - .08
Arsenate, powd., bag, lb.	.60 - .
Lithopone, bags, lb.	.24 - .
Magnesium carb., tech., bags, lb.	.23 - .25
Methanol, 95%, tanks, gal.	.104 - .104
Synthetic, tanks, gal.	.094 - .12
Phosphorus, yellow, casks, lb.	.07 - .074
Potassium bichromate, casks, lb.	.534 - .
Chlorate, powd., lb.	.08 - .09
Hydroxide (caustic potash) dr., lb.	.104 - .20
Muriate, 60%, bags, unit.	.16 - .17
Nitrate, ref., bbl., lb.	.0515 - .06
Permanganate, drums, lb.	1.00 - 1.05
Prussiate, yellow, casks, lb.	15.00 - .
Sai ammoniac, white, casks, lb.	1.05 - .
Salsoda, bbl., 100 lb.	1.15 - .
Salt cake, bulk, ton	2.30 - 3.00
Soda ash, light, 58%, bags, contract, 100 lb.	.054 - .06
Dense, bags, 100 lb.	1.70 - 2.00
Soda, caustic, 76% solid, drums, 100 lb.	.074 - .08
Acetate, del. bbl., lb.	16.00 - 17.00
Bicarbonate, bbl., 100 lb.	.03 - .04
Bichromate, bags, lb.	.03 - .04
Bisulphate, bulk, ton	.03 - .04
Bisulphite, bbl., lb.	.03 - .04

which Stainless *shall I use?*



MINE CARS?

Our mine cars handle a moist abrasive acid ore. Can we get a Stainless Steel that will stand up under the abrasion, and also resist the acid corrosion?

HEAT TREATING EQUIPMENT?

Our heat treating furnaces operate up to 1,500° F. Can we replace the hoods with Stainless? If so, which grade do you suggest?

CHEMICALS?

We are thinking of using Stainless Steel sheets for the lining of our dye vats. What grade and finish of Stainless Steel would you recommend?

MARINE HARDWARE?

Please send us your recommendation for the best grade of Stainless Steel for use in marine hardware, including rudders and fins.

**ask
Eastern
for the
answer
when
Stainless
is the
question**



Such questions on Stainless Steel selection are typical of questions which Eastern Stainless representatives answer every day. Eastern Stainless offers all the stainless grades you need for specialized applications of stainless steel sheet and plate. Consult Eastern on your selection problem.

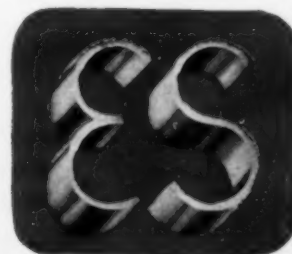
Many of the answers are in the 96-page "Eastern Stainless Steel Sheet" handbook which, because of the great demand for copies, is now in its second printing. Write for your copy on your company letterhead.

JANUARY 1946

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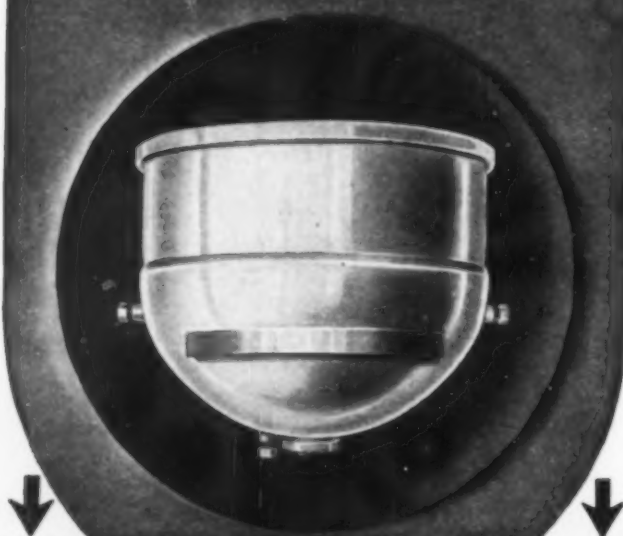
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CHEM. & MET.

Weighted Index of Prices for OILS & FATS

Base = 100 for 1937

This month.....	145.93
Last month.....	145.63
January, 1945.....	145.56
January, 1944.....	145.24

Chlorate, kegs, lb.....	\$0.06	\$0.084
Cyanide, cases, dom, lb.....	.14	.15
Fluoride, bbl, lb.....	.07	.08
Hyposulphite, bags, 100 lb.....	2.25	2.50
Metasilicate, bbl, 100 lb.....	2.50	2.65
Nitrate, bulk, ton.....	27.00	
Nitrite, casks, lb.....	.08	.07
Phosphate, tribasic, bags, 100 lb.....	2.70	
Prussiate, yel, bags, lb.....	.10	.11
Silicate, 40°, dr, wks, 100 lb.....	.80	.85
Sulphite, crys, bbl, lb.....	.02	.024
Sulphur, crude at mine, long ton.....	16.00	
Dioxide, cyl, lb.....	.07	.08
Dioxide, tanks, lb.....	.04	
Tin crystals, bbl, lb.....	.39	
Zinc chloride, grain, bbl, lb.....	.05	.06
Oxide, lead free, bags, lb.....	.07	
Oxide, 55% leaded, bags, lb.....	.07	
Sulphate, bbl, cwt.....	3.85	4.60

OILS AND FATS

Castor oil, No. 3 bbl, lb.....	\$0.13	\$0.144
Chinawood oil, tanks, lb.....	.38	
Coconut oil, ceylon, N. Y., lb.....	.085	
Corn oil crude, tanks (f.o.b. mill), lb.....	.12	
Cottonseed oil crude (f.o.b. mill), tanks, lb.....	.124	
Linseed oil, raw, car lots, bbl, lb.....	.15	
Palm, casks, lb.....	.085	
Peanut oil, crude, tanks (mill), lb.....	.12	
Rapeseed oil, refined, bbl, lb.....	nom.	
Soybean, tanks, lb.....	.11	
Menhaden, light, pressed, dr, lb.....	.13	
Crude, tanks (f.o.b. factory) lb.....	.089	
Grease, yellow, loose, lb.....	.08	
Oleo stearine, lb.....	.09	
Oleo oil, No. 1, lb.....	.11	
Red oil, distilled, bbl, lb.....	.13	
Tallow extra, loose, lb.....	.084	

COAL-TAR PRODUCTS

Alpha-naphthol, crude, bbl, lb.....	\$0.52	\$0.55
Alpha-naphthylamine, bbl, lb.....	.32	.34
Aniline oil, drums, extra, lb.....	.11	.124
Aniline salts, bbl, lb.....	.22	.24
Benzaldehyde, tech, dr, lb.....	.45	.50
Benzidine base, bbl, lb.....	.70	.75
Benzoin acid, USP, kegs, lb.....	.54	.58
Benzol, 90%, tanks, works, gal.....	.15	
Benzyl chloride, tech, dr, lb.....	.22	.24
Beta-naphthol, tech, drums, lb.....	.23	.24
Cresol, USP, dr, lb.....	.104	
Cresylic acid, dr, wks, gal.....	.81	.83
Diphenyl, bbl, lb.....	.15	
Diethylaniline, dr, lb.....	.40	.45
Dinitrotoluol, bbl, lb.....	.18	.19
Dinitrophenyl, bbl, lb.....	.22	.23
Dip oil, 15%, dr, gal.....	.23	.25
Diphenylamine, dr, f.o.b. wks, lb.....	.25	
H acid, bbl, lb.....	.45	.50
Hydroquinone, bbl, lb.....	.90	
Naphthalene, flake, bbl, lb.....	.07	.074
Nitrobenzene, dr, lb.....	.08	.09
Para-cresol, bbl, lb.....	.41	
Para-nitraniline, bbl, lb.....	.47	.49
Phenol, USP, drums, lb.....	.10	.11
Picric acid, bbl, lb.....	.35	.40
Pyridine, dr, gal.....	1.55	1.60
Resorcinol, tech, kegs, lb.....	.65	.70
Salicylic acid, tech, bbl, lb.....	.26	.33
Solvent naphtha, w.w., tanks, gal.....	.96	
Toludin, bbl, lb.....	.32	
Toluol, drums, works, gal.....	.32	
Xylol, com., tanks, gal.....	.25	

MISCELLANEOUS

Casein, tech, bbl, lb.....	\$0.21	\$0.24
Dry colors		
Carbon gas, black (wks), lb.....	.0365	.007
Prussian blue, bbl, lb.....	.36	.37
Ultramarine blue, bbl, lb.....	.11	.26
Chrome green, bbl, lb.....	.23	.33
Carmines, red, tins, lb.....	4.60	4.75
Para toner, lb.....	.75	.80
Vermilion, English, bbl, lb.....	2.50	2.60
Chrome, yellow, C.F., bbl, lb.....	.16	.17
Gum copal, Congo, bags, lb.....	.09	.55
Manila, bags, lb.....	.09	.15
Damar, Batavia, cases, lb.....	.10	.22
Kauri, cases, lb.....	.18	.60
Magnesite, calc., ton.....	64.00	
Pumice stone, lump, bbl, lb.....	.05	.07
Rosin, H., 100 lb.....	7.43	
Shellac, orange, fine, bags, lb.....	.46	
Bleached, bonedry, bags, lb.....	.424	
T. N. bags, lb.....	.354	
Turpentine, gal.....	.934	.944

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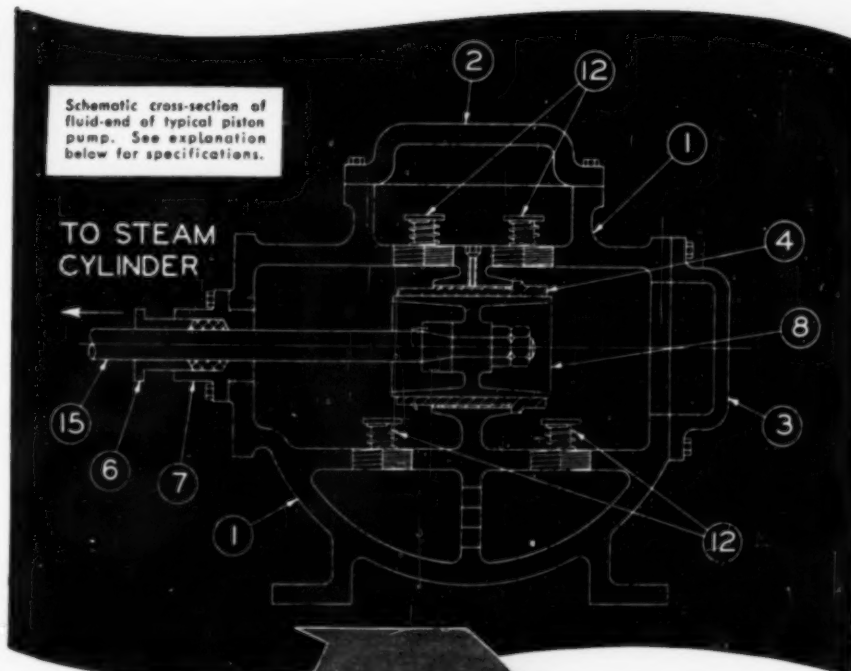
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3. End cover — Ampcoloy A-3 usually recommended.
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7. Stuffing box — Ampco Metal Grade 18 usually recommended.
8. Piston — Ampcoloy A-3 or Ampcoloy 40 usually recommended.
12. Valves — Recommendation depends upon design.
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P-3

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NEW CONSTRUCTION

PROPOSED WORK

Ark., Wilson—Helena Cotton Oil Co., Helena, plans to construct a new method processing plant for cotton seed oil here. Estimated cost \$250,000.

Calif., San Jose—Superior Match Co., 7530 South Greenwood St., Chicago, Ill., plans to construct a factory here. Estimated cost \$250,000.

Calif., Anaheim—General Electric Co., 212 North Vignes St., Los Angeles, is having preliminary plans prepared by A. C. Martin, Archt., 233 Higgins Bldg., Los Angeles, for the construction of a 1 story plastic factory here; also a chemical factory for the manufacture of glyptal alkyd resins for paint base. Plans for latter project being drawn by Blaw-Knox Chemical Div., P. O. Box 5087, East Liberty Sts., Pittsburgh, Pa. Estimated cost \$500,000 and \$50,000 respectively.

Ga., Tucker—E. I. du Pont de Nemours & Co., Wilmington, Del., contemplates the construction of a fabrics processing plant and paint and varnish manufacturing plant here. Estimated cost \$6,000,000.

Ill., Peoria—Hiram Walker & Sons, Inc., foot of Ehrman St., plans to construct a new rack house for distillery to add 110,000 bbl. storage capacity to warehouse facilities. Estimated cost including equipment \$1,000,000.

Ind., Terre Haute—Owens Illinois Glass Co., Terre Haute, plans to construct an addition to its plant. Estimated cost \$100,000.

La., Lake Charles—Mathieson Alkali Works, Lake Charles, plan to construct facilities here for the manufacture of sodium nitrate. Estimated cost \$1,000,000.

N. J., Millville—Lab Glass Co., Pine St. near High St., plans to repair its factory recently damaged by fire. Estimated cost \$40,000.

N. Y., Syracuse—Solvay Process Co., Milton Ave., plans to construct a laboratory. Estimated cost \$500,000.

N. C., Burlington—Celanese Corp. of America, H. W. Flynn, Plant Mgr., plans to double the capacity of its plant here. Estimated cost \$750,000.

CONTRACTS AWARDED

Calif., Los Angeles—Gladding-McBean & Co., 2901 Los Feliz Blvd., will construct a new factory for the manufacture of clay products. Work will be done by owner. Estimated cost \$52,000.

Calif., Long Beach—Ohio Rubber Co., Wiloughby, O., has awarded the contract for the construction of a rubber plant here to Wm. P. McNeil Co., 4814 Loma Vista St., Vernon, Calif. Estimated cost \$1,000,000.

Calif., Van Nuys—Pomona Tile Manufacturing Co., 629 North La Brea Ave., Los Angeles, has awarded the contract for a factory here to The Austin Co., 777 East Washington Blvd., Los Angeles. Estimated cost \$130,000.

Conn., Hamden—Plasticrete Corp., 1883 Dixwell Ave., has awarded the contract for a

machine shop and office building to Patterson Construction Co., 66 Anderson St., New Haven. Estimated cost \$50,000.

Ga., Atlanta—Spencer-Adams Paint Co., Foster St. near Huff Rd., has awarded the contract for a 1 story, 99 x 101 ft. factory to The Flagler Co., 305 Techwood Dr. Estimated cost \$45,000.

Ga., Waycross—Turpentine Farmers Cooperative, Waycross, will construct a modern steam distillation plant for processing naval stores and turpentine products. Work will be done with own forces. Estimated cost \$150,000.

Ill., Bellwood—Sanford Ink, 846 West Congress St., Chicago, has awarded the contract for a 1 and 2 story factory to Bulley & Andrews, 2040 West Harrison St., Chicago. Estimated cost \$300,000.

Ill., Chicago—Armour & Co., U. S. Yards, has awarded the contract for a 3 story, 52 x 120 ft. laboratory to Stanley A. Nelson, 543 West 79th St. Estimated cost \$180,000.

Ill., North Chicago—Abbott Laboratories, North Chicago, has awarded the contract for a laboratory building to Carroll Construction Co., 333 North Michigan Ave., Chicago. Estimated cost \$200,000.

Md., Baltimore—Maryland Glass Corp., 2147 Wixomco St., has awarded the contract for a glass bottle manufacturing plant to Cummins Hart Construction Co., 2023 North Charles St. Estimated cost \$227,000.

Mass., Cambridge—B. B. Chemical Co., 784 Memorial Dr., has awarded the contract for a plant to Aberthaw Co., 80 Federal St., Boston. Estimated cost \$75,000.

Mich., Midland—Dow Chemical Co., Midland, has awarded the contract for a 3 story 240 x 300 ft. plastics plant warehouse to The Austin Co., 429 Curtis Bldg., Detroit. Estimated cost \$2,500,000.

N. J., Newark—Irvington Varnish & Insulator Co., 476-502 Doremus Ave., has awarded the contract for a plant here to H. K. Ferguson Co., Inc., Hanna Bldg., Cleveland, O.

N. J., North Bergen—Gibraltar Corrugated Paper Co., Inc., North Bergen, has awarded the contract for a paperboard mill to M. Shapiro Construction Co., Inc., 254 West 54th St., New York, N. Y. Estimated cost \$1,000,000.

N. Y., Tonawanda—Lucidol Corp., 1740 Military Rd., Buffalo, has awarded the contract for a plant to Mahony-Troast Construction Co., 657 Main Ave., Passaic, N. J. Estimated cost \$50,000.

	Current Projects		Cumulative 1945	
	Proposed Work	Contracts	Proposed Work	Contracts
New England.....		\$170,000	\$3,325,000	\$17,754,000
Middle Atlantic.....	\$340,000	4,067,000	9,792,000	41,628,000
South.....	7,750,000	1,515,000	59,828,000	40,861,000
Middle West.....	1,100,000	8,300,000	13,399,000	75,557,000
West of Mississippi.....	250,000	3,475,000	10,156,000	104,938,000
Far West.....	800,000	1,182,000	21,795,000	26,066,000
Canada.....			9,219,000	3,331,000
Total.....	\$10,440,000	\$18,799,000	\$127,514,000	\$310,135,000

N. C., Hickory—Hyalyn Porcelain, Inc., 225 Arcade Bldg., has awarded the contract for a porcelain plant to Elliott Building Co., Hickory. Estimated cost \$70,000.

N. C., Old Fort—United Merchants & Manufacturers Management Corp., 1412 Broadway, New York, N. Y., has awarded the contract for the construction of a rayon finishing plant here to Potter & Shackelford, Inc., Greenville, S. C. Estimated cost \$1,250,000.

O., Cleveland—Ferro Enamel Co., 4150 East 56th St., has awarded the contract for plant to Leo W. Schmidt, 10000 Granger Rd., Garfield Heights, O. Estimated cost \$60,000.

O., Toledo—Plaskon Div., Libbey-Owens-Ford Glass Co., Nicholas Bldg., has awarded the contract for several multi-storied manufacturing facilities for resins and moulding powders (plastics) to Stone & Webster Engineering Corp., 49 Federal St., Boston. Estimated cost \$5,000,000.

O., Wickliffe—Lubrizoil Corp., St. Clair Ave. and Lloyd Rd., has awarded the contract for a factory building to Sam W. Emerson Co., 1836 Euclid Ave., Cleveland. Estimated cost \$150,000.

Pa., Springdale—Pittsburgh Plate Glass Co., 632 Duquesne Way, has awarded the contract for a paint plant here to Siesel Construction Co., 3528 Forbes St., Pittsburgh. Estimated cost \$1,750,000.

Pa., Tyrone—Corning Glass Co., Walnut St., Corning, N. Y., has awarded the contract for a plant and office building to H. K. Ferguson Co., Hanna Bldg., Cleveland, O. Estimated cost \$1,000,000.

R. I., East Providence—Rhode Island Paint & Varnish Co., King Phillip Rd., has awarded the contract for a paint plant to Joseph Flynn, 112 Lenox Ave., Providence. Estimated cost \$45,000.

Tex., Beaumont—Pittsburgh Plate Glass Co., 101 Crawford St., Houston, will construct a glass plant unit. Work will be done by owners. Estimated cost \$75,000.

Tex., Freeport—Dow Chemical Co., Freeport, has awarded the contract for the construction of a Perclorethylene plant unit to Tellepsen Construction Co., 3900 Clay Ave., Houston. Estimated cost \$2,000,000.

Tex., Holliday—Warren Petroleum Corp., National Bank of Tulsa Bldg., Tulsa, Okla., has awarded the contract for the construction of a natural gasoline plant here to J. F. Pritchard & Co., National Bank of Tulsa Bldg., Tulsa, also one at Wichita Falls. Estimated cost \$650,000 and \$750,000 respectively.